The
Geographical Journal.

No. 3. MARCH, 1909. Vol. XXXIII.

A JOURNEY FROM TRIPOLI ACROSS THE SAHARA TO LAKE CHAD.*

By HANNS VISCHER.

The travellers who have left Tripoli for the interior represent such an important page in the exploration of Africa and the history of this Society, that I think you will permit me to recall their names before laying before you an account of my own journey.

In 1799 Frederic Conrad Hornemann returned from Tripoli to Murzuk, where he had arrived from Cairo on his way to Bornu and Nupe. Joseph Ritchie and Lieut. Francis Lyon followed, but they only got as far as Murzuk. In 1822 Major Denham, Clapperton, and Oudney crossed the desert from Tripoli to bring back the first definite news from the Chad countries and the Hausa states. Dr. Henry Barth left the coast in 1850 with Richardson and Overweg, and was followed by Dr. Vogel three years later. When Barth returned alone, he had seen the Niger at Timbuktu and the Binue at Jola, had crossed the Shari, and been a prisoner in Wadai. Moritz von Beurmann, who was murdered in Wadai, like Vogel, left Tripoli in 1862. The first to reach the West Coast from the north was Gerhardt Rohlfs, who started in 1865 and reached Lagos by way of Bornu, Bauchi, and Illorin. Four years later Dr. Gustav Nachtigal left Tripoli with presents from King Wilhelm of Prussia for Sheikh Omar of Bornu on his famous journey which took him to Tibesti, Borku, and Kanem, and finally across Wadai, Darfur, and Kordofan to Khartum.

The first officer of European administration which during the following years had claimed the countries from the West Coast to Lake

* Read at the Royal Geographical Society, January 11, 1909. Map, p. 352.

Chad, a Frenchman, Lieut. Colonel Monteil, arrived in Tripoli from Bornu.

The countries where the former travellers had risked their lives were now opened to European enterprise, and the best strip of land from the Oil Rivers to Lake Chad had been secured to British interests by the founder of the Royal Niger Company, Sir George Taubman Goldie.

I left Tripoli in July, 1906, as an officer of the Government of Northern Nigeria to join my post in Bornu. The circumstances have considerably changed in Tripoli since the days when Colonel Warrington, the British Consul, whose word was a passport throughout the Sahara, put European travellers on their road to the south. After the centuries of wars and revolutions which devastated the Barbary States, Tripoli and Fezzan came to depend entirely on trade. The trans-Saharan trade to Bornu and the Hausa state soon degenerated into slave traffic. Then following the official prohibition along the coast, British Administration stopped the export of slaves from Kano and Bornu. Slave traffic ceased altogether, and with it the greatest source of income of the Arab traders, the influential people in Tripoli and Fezzan.

European administration on both sides of Tripoli, in Egypt and Tunis, has, in the eyes of many less enlightened inhabitants of the vilayet, made Tripoli a last refuge of the faithful in North Africa, an uncontaminated country which should at all costs be protected against European influences. Moreover, certain newspapers had spoken of a European occupation of Tripoli. All this made my proposed journey along the old caravan route a matter of the greatest difficulty, and it was after months of delay that I at last saw the palm-groves of Tripoli disappear behind the sand-dunes. I had with me some thirty negroes, freed slaves, mostly from the Chad countries, whom I had drilled into a kind of escort, and Mecca pilgrims from Nigeria, who wished me, an officer of their Government, to repatriate them. Some fanatical intrigue drove away the best men I had; only the very poor remained, and such as had good reason to leave the coast. Besides, to retain them, I was forced to take with me the men's women and children, an accessory which does not help a traveller across the desert when each meal and every drink of water must be calculated.

I hired camels at Tripoli from the Megarha, a Beduin tribe living on the northern border of Fezzan, to carry my loads as far as Murzuk. Here I bought some animals and hired others from the Tubbu Reshade as far as Bilma. From Bilma to Bornu I was allowed to march with a French expedition, whose commandant Gadel very kindly supplied me with transport.

The road took us first from Tripoli to the foot of the mountains which run parallel to the coast-line from Morocco to the Greater Syrtes through Tunis and Tripoli, leading in and out amongst great sand-dunes

and past occasional patches of cultivation and little villages. We entered the flat-topped hills at Gharian by the Wadi Erba. From Gharian the caravan route passes almost due south over numerous ridges and across waddis, running uniformly from west to east, to the village and oasis of Misda in the Wadi Sofejin. Then we turned slightly east to the Wadi Zemzem and the wells of Tabonia, over freshly broken plateaus and deep-cut valleys. Tabonia lies on the northern edge of the Hamada el Homra, the "red wilderness" that closes the mountainous region towards Fezzan and the south.

Where the road crosses it the Hamada is 150 miles broad—an immense plateau of red rock with hardly any vegetation and only one route across. Barth and his expedition used this route, only they marched on to El Hassi, a little south of the well where we stopped. This well, called by the Arabs Weina, lies in a deep valley, which breaks into the rocky escarpment, the "Gate of the Hamada."

For three days then we marched over immense fields of broken rock, the ruins of a former plateau, to the first valley of Fezzan, the Wadi Shiati, and the village of Wunzerig. Pointing due south again, the road passed over a regular sea of sand-dunes to the low level of the Wadi Gerbi and Tekertiba. A steep wall of rock closes the valley to the south, the black colour of the stones in beautiful contrast to the bright sand-dunes on the other side. A steep mountain path, the road climbed the hills to the high level which gradually slopes down towards the depression of Murzuk and the open desert. Many palm groves on either side of the road showed the presence of water near the surface.

Murzuk itself stands in a line of depressions which are marked by uneven plantations of date-palms, along which the road passes to the east for some days. Then it turns to the south again till it strikes another depression at Gatrun. The oasis of Gatrun is protected from the drifting sand-dunes to the east by a ridge of decaying rocks, which rise to their highest point at the southern extremity called Ras Tejerri after the last village in the oasis. Gatrun is the most southern one of the various oases collectively called Fezzan. From Tripoli to Tejerri we had marched forty-three days.

South of Gatrun the real desert began as we marched quickly past the Bir Meshru over broad *serirs* and large waterless valleys to the black mountains of Tummo or El War, "the difficult ones," as the Arabs name them. From Gatrun to the camps south of Tummo the country was bare of any vegetation, and many of the old water-holes have disappeared. In long marches, always in due southerly direction, we covered the wide stretches between the uninhabited oases of Jat and Jeggeba, and then, as the country opened out, and wide sandy plains took the place of the mountains, the oasis of Kauwar came into sight. This oasis, like Gatrun, has a ridge of hills which guard it to the east from the encroaching sand. Many villages lie at the foot of

these rocks in the well-watered depression along which we passed to Bilma, the most southern point.

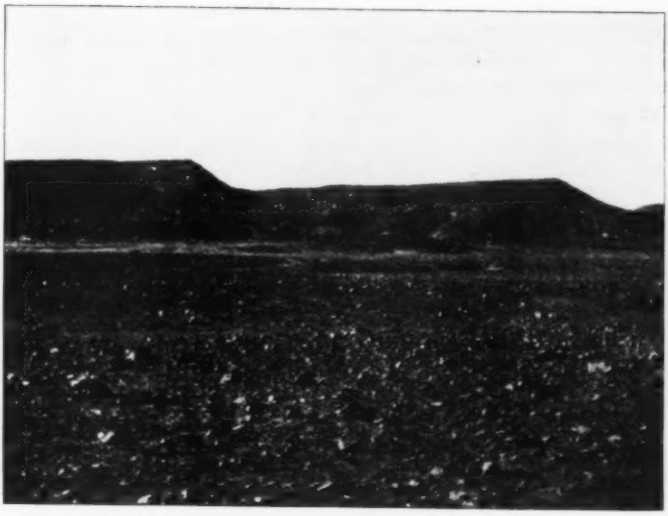
Continuing due south, the route passes first the last hills of the Kauwar range, and then by the wells of Zo Kora and Dibbela, leads over endless gigantic sand-dunes to Agadem, where some bushes and dum palms mark the presence of water. Then the great sandy plain, the Tintumma, took up the road for 75 miles, flat and desolate at first, but undulating and green as we advanced southward. The desert disappeared gradually as mimosas and acacias showed on either side, and when we had passed down a kind of valley to the well of Beduaram, the familiar African bush surrounded us.

Seven more marches, always in the same direction, passing frequent dried-up water-holes, brought us a ridge of sand-dunes by the village of Ngigmi. Below us the depression of Lake Chad, a dark sheet of green reeds and rushes, stretched far away to the southern horizon. From Ngigmi village we skirted the edge of the Chad depression, now waterless, through the ruins of Barrua and the little town of Bosso, and finally crossed the Komadugu Wobe into Bornu and Northern Nigeria.

The country the road crosses from the Mediterranean to Lake Chad is naturally divided into three parts. The northern part, from Tripoli to Fezzan, with a regular rainfall during the winter months; Fezzan and the southern desert, where rain is either extremely scarce or unknown; and, finally, the southern end, beginning with the Tintumma plain, where the tropical rains are known by occasional thunderstorms.

The Saharan desert is a comprehensive term often used to describe the whole country from the Mediterranean to Lake Chad. If the expression is used to denote a place where destructive nature has triumphed over man it is just. Except the few solid rocky plateaux, the whole land was once inhabited by man. From the ruined towns near Tripoli, and the monuments of ancient art and industry in the northern mountains, to the prehistoric stone implements strewn amongst the oases to the south, the few struggling villages in the depressions of Fezzan, and in places where the natural formation of the ground protect a few water holes, all show the various stages of this struggle of man against nature, and the unavoidable end, the dead, waterless desert. On my journey I had special opportunities to study this process of destruction, and the means by which man has often withstood it successfully. As in tropical Africa the forest will cover up the ground when man retreats, so the desert, with the aid of wind, sun, and the changes of temperature, claim all ground when once left alone.

In physical character the desert changes along the road continually from fantastically torn mountains to softly undulating dunes and wide sandy plains. The newest desert is the northern portion, where the winter rains still fall regularly. This could no doubt be reclaimed, as



MOUNTAINS BETWEEN MISDA AND TABONIA.

LANDSCAPE NEAR MISDA.

the French have begun to reclaim the once deserted country in Algiers and Tunis. From Tripoli to Fezzan the desert only asserted itself after the Roman Empire had fallen, and Moors, Vandals, and Byzantines had swept over the country till the advent of the Mohammedan conquerors.

At the back of Tripoli town the ground consists of deposits which the winter torrents bring down from the mountains, ever since the Roman terraces have crumbled away. On this surface the wind has built up high dunes with the sand from the seashore. These dunes move for ever about, covering and uncovering the deposits from the mountains. On a comparatively small place recently uncovered by a moving dune I picked up a collection of implements of generations which once peopled the now deserted mountain slopes—flint arrow-heads and knives of prehistoric times, Phœnician, Carthaginian, and Roman coins, slabs of polished marble, and many-coloured mosaics.

No woods now remain on the mountains, and when the winter rains come down they do so in regular cloud-bursts, which sweep away all the loose soil between the rocks and rush down into the plain below in wild torrents. How violent these torrents can be was seen a few years ago, when the water rushed down through the gardens of the oasis to the very walls of Tripoli, destroying whole plantations and houses, till it at last found an outlet into the harbour.

On the northern edge of the mountains the little land of Gharian, with its villages and gardens, stands like an island amongst the general destruction. The gardens of Gharian were famous in the times of Leo Africanus for their fertility, and to this day the old Roman terraces have withstood the keen wind from the sea and the winter rains, and give one an idea of the country's former prosperity. The village of Gharian lies amongst ancient olive groves and large fruit gardens, built on the old terraces. Ruined castles look down from every little hill, old Roman or Pornician towers. The present inhabitants live in underground houses, hewn out of the solid rocks, the ancient dwellings probably of some prehistoric race. A curious maze of earth mounds, which rose on either side of the road, showed the position of the village. From one of these mounds, the rubbish taken out of the ground when the house was built, I looked down into a square courtyard about 30 feet below the ground, with walls hewn perpendicularly out of the red rock. Around the walls several doors and narrow slit windows showed the different rooms. The master of the house then led us to a door which was built above the ground, like the entrance to some cellar, and down a narrow passage or tunnel to the courtyard below. The first apartment we came to held several donkeys and some goats, and was used as a stable. The living rooms were all whitewashed, and, like the court-yard, exceedingly clean. It looked most picturesque—the little house with the whitewashed arches leading into the rooms, the red sides of the rock covered partly by a fresh green creeper, and over it all the square

of dark blue sky. The inhabitants praise their houses, for they are cool in summer and warm in winter, when the cold north-east wind blows, but they know nothing of the original builders.

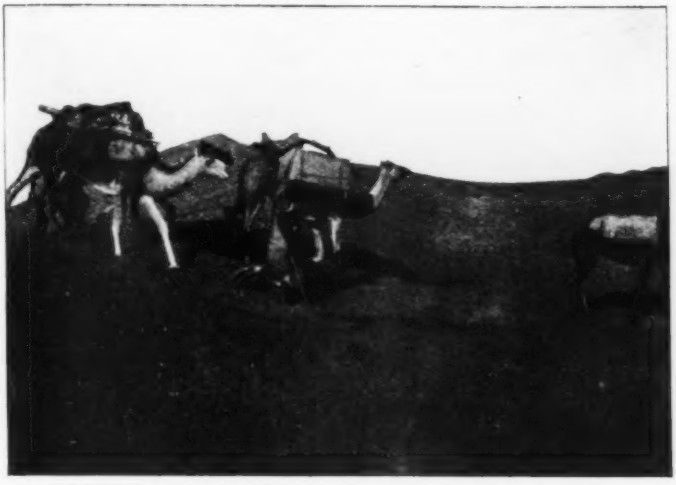
I might mention here that I found in an old chronicle of the Bolawa tribe, between Lake Chad and the Binue, a passage which says that long ago the tribesmen lived in houses dug out of the rock as one digs a well. A little further in the village a curious white dome, just rising above the ground, was pointed out to me as the Jewish synagogue. Jewish communities are numerous in these mountains.

Leaving Gharian, the country at once took a much wilder aspect. Ruins of old terraces were still seen occasionally with small bits of cultivated ground. All around the winter rains had long ago washed away every particle of loose soil, and the naked rocks were cracked and breaking up under the action of wind and sun. Broken watch towers and old tombs, landmarks that guide the caravan through the waterless valleys and past large cisterns, now filled up with rubbish, remind one of former inhabitants where now only occasional caravans hurry through between distant water-holes.

The oasis and village of Misda, where we camped on our way south, stands in the valley of Sofejin, once famous for its fertility as far as Andalusia, in Spain. Now Misda the village is a collection of tumble-down hovels, and a few sad-looking palm-trees remain of all the former gardens. It has not rained at Misda for twelve years, and water-level has sunk so far below the surface that the palm-trees cannot reach it. The whole valley, as far as one can see, is covered with rocks brought down from the surrounding mountains, when the winter rains went down on the distant plateaus, and the torrents swept all loose stones and rubbish into the low-lying valley. Here and there, lost amongst the general ruin, an old pillar that once held the waterwheels over a well shows the extent of the former gardens. Even since the days of Barth and Nachtigal the desert has advanced here. Where I found only desolate wastes of rubbish these travellers saw gardens and cornfields.

At Tabonia, at the edge of the Hamada el Homra, the monuments of Roman enterprise still look proudly over the expanse of red rock to the south. Amongst the heaps of loose stones one can trace the ancient stone troughs that served former caravans, though now all is broken up, and the stones with the proud Roman eagles serve the passing Arab to stay his cooking-pot over the fire.

I visited Gherria, which lies an hour to the east of Tabonia. The old Roman towers over the dark palm-grove in the valley below cannot fail to impress one as they show against the sky between dark plateaus and wadis to the north and the red expanse of the Hamada to the south. Over the old gateway stands the inscription "Prov. Af. Il." (*Provincia Africa Illustris*), a striking contrast to the few sickly looking inhabitants which resented our intrusion like a sick animal tracked to its layer.



CAMELS CROSSING SAND-DUNE IN FEZZAN.

WADI GERBI.

Another inscription says that Publius Nero built the place as a fortified camp for the Severian troop of the twenty-first legion under Marcus Aurelius Severus.

From the sea to the Hamada el Homra, the once inhabited country between Fezzan and the coast, the progress of the desert can be seen all along the route in its various stages. If nature is allowed to continue in her work unhindered, as during the last few centuries, the country will soon become absolute desert. Though the climate has scarcely changed, rains are limited to a shorter period, and, while they are more violent while they last, their area has been greatly reduced.

At Misda it has not rained for twelve years, but the torrents caused by the rains at some distance will rush down the valley with such swiftness and force that men and their flocks are often drowned. The Beduin have a way of calling to each other from different points along the valleys, and every man hearing the call will flee up the mountain-side. When these rains have washed away all the loose earth from the plateaux and the valleys, the wind and the sun will attack the open rock. Numberless valleys have been cut into the original plateau, generally in the direction from east to west. On the open cliffs the continual changes of temperature will start the chemical decomposition of the rock, and the wind blowing for ever through every crack and fissure carries away all loose particles of sand. Little by little the harder rocks are loosened from their surroundings and roll to the valley below, the cliff crumbles away, and the next torrent will carry all off. The different layers of exposed rock often show brilliantly in their different colouring amongst the generally dark surroundings.

Sometimes the wadis which cut into the plateau separate large pieces from the latter which form fresh mountains by themselves, where wind and sun at once set to work till they have been reduced to the level of the surrounding stonefields. Such hills can be seen in all stages of decomposition along the road. Some still bear on their tops pieces of the original plateau like some weird cap, others have been formed into conical hills of all heights, and in some places only a slight rise of the ground marks the original site of a hill.

The various plateaus which we crossed all resembled the Hamada el Homra, but in beauty and desolation that great rock surpasses them all. Before crossing the Hamada el Homra, caravans usually wait for each other, for on this dangerous route there is safety in numbers. A storm from the south, a slight mistake in the direction, has been fatal to many a caravan, for on either side opens the waterless desert.

We were a caravan of nearly fifteen hundred camels when we finally left Tabonia after a few days' rest at the wells and slowly marched up the slope to the high plateau. As far as the eye could see, the red plain danced and glowed in the sun. Little red stones covered the surface, the remains of former layers that have rotted and been cleared away by

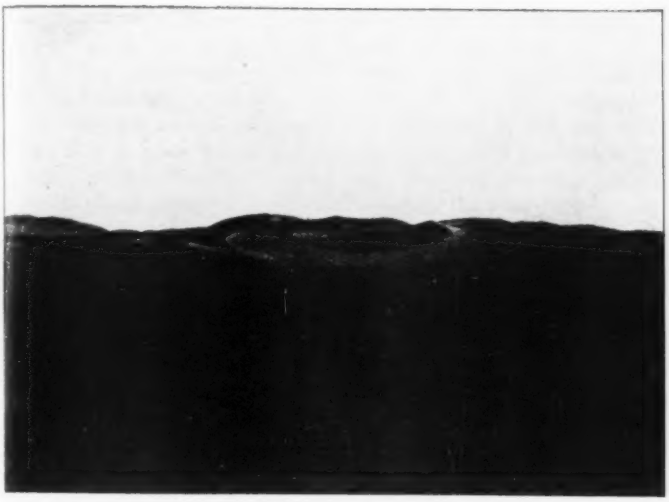
the continual wind which sweeps the surface like a broom. The well-polished stones glittered in the sun, threw back the rays of the sun; the air danced and trembled, reflecting the blue sky in every depression of the ground and distorting every dark object into fantastic shapes. Every hollow in the rock looked like a blue lake, and men and camels appeared as dark palm-groves or strangely shaped hills. "Behold the devils!" said the Arabs as these mirages appeared and vanished as we marched along.

As the sun went below the sky-line and the wind dropped, the silence of the Hamada settled around us. The stars rose with wonderful clearness, one by one, over the sharp horizon and up into the dark blue sky. The moon went down as if suddenly it had been covered by a black board. Without any noise the fifteen hundred camels moved on through the silent night with an even, steady movement, till at last Orion swung clear of the eastern horizon and Sirius shone out like a light at sea. At last the first indefinite signs of day appeared. A little red cloud set the whole sky on fire; then a brilliant yellow light threw back the darkness of night, and the first sharp rays of the sun struck the vast plain as with a blow and turned it all into life and colour. The spectacle in the evening was, if possible, still more wonderful. All the desolation and the death of the forbidding rock vanished before that sunset.

When the sun had gone down, a clear white pyramid rose into the sky. On either side streaks of vivid red and gold followed the horizon far to north and south. Higher up red and gold turned with never a break into soft rose colour, and this into light green, which somewhere melted away into the transparent blue of the evening sky. As the first stars appeared the pyramid sank lower and lower, the red and gold shut in ever closer, till at last only a brilliant glow remained over the place where the sun had vanished, long after night had closed over the great plain and stars and moon looked from afar on silent caravan.

To the south the Hamada falls off in a sheer cliff of crumbling rock. The red colour of the higher layers looks beautiful against the light blue of the far levels. From the mouth of the little valley the Bab el Hamada by which we reached the open plain below the line of the great plateau can be seen far away to the east and west. A fringe of broken stone-fields, the decaying remains of ancient Hamada nearly 80 miles broad, separate the great plateau from the Wadi Shiati, the first valley of Fezzan.

What I saw between Tripoli and Fezzan of the formation of the desert confirmed entirely the theories laid down by Prof. Johannes Walther. The history of this country shows clearly that the desert does not drive away man, but will claim any ground left by him. In Fezzan the country and the character of the desert are different. The wind from the north-east brings the sand from the mountains in ever



SAND-DUNES SOUTH OF WADI SHIATI.

UNDERGROUND HOUSE AT GHARIAN.

increasing quantities and piles it up in gigantic sand-dunes as the decomposition of the northern plateau advances, and the unfortunate history of Fezzan has reduced the population to numbers insufficient to successfully defend the fertile soil against the sand-dunes.

The first depressions of Fezzan which we crossed, the Wadi Shiati and the Wadi Gerbi, are now separated by enormous sand-dunes which have increased in size since our last travellers visited them. These dunes rise in some places to a height of over 600 feet and vary continually in shape, so that a guide must always precede the caravan to find where the ground is hard enough to bear the loaded animals. Even then the camels often sink into the sand up to their knees, and the progress of the caravan is very slow. In between the dunes where the sand does not cover the original surface water is always found, and in two places at Trona and Mandara it forms into small lakes and swamps surrounded by reed grass and date palms. In both these places there are deposits of natron and potash.

Fezzan is the name for a number of oases where water is plentiful and near the surface. In most places the ground in the oases has salt deposits on the surface. But at some depth the water is always sweet. Where the oases are not protected by some rocks or ridges they are gradually being covered up by the drifting sand.

Mounting the black wall of rocks which borders the Wadi Gerbi to the south, we came on a number of beautifully fossilized tree-trunks. All the trunks were lying in the same position, from south to north, and looked like the dead trees one finds on the mud-banks in the delta of some equatorial stream. From later information I learnt that this line of fossils stretches along the escarpment for over 120 miles on either side.

The little land of Phasania, the country of the Garamantes, has been known since the days of Herodotus for its fertility, and through its important position on the great caravan routes from Egypt to Timbuctu, and from the north coast to the Chad countries, always played some part in North African history. The Romans occupied it, and every successive conqueror sent his armies there until the Arabs came, and centuries of wars and revolutions devastated the country until the arrival of the Turks. Then, depopulated and wasted, the country existed for some time on the trade which passed through to the interior, and when this vanished, the few remaining inhabitants, unable to continue their struggle against the desert, started to migrate towards the coast, as they are doing now, and the doors were opened to the surrounding sand-dunes.

One sees in Fezzan, as at Mestuta and in the oasis of Gatrun, mighty mud castles that once stood in the centre of large towns whose walls can still be traced. Now these huge structures stand alone in the bare desert. In the Wadi Shiati, and around Murzuk, and throughout the depression of Gatrun, many palm groves have been invaded by

the sand and the trees are dying off. Every trace of the old water-holes has vanished beneath the sandhills. One can see disappearing oases in every stage of neglect throughout Fezzan, and nothing will stop the ultimate triumph of the desert unless the authorities find means to repopulate the land.

To protect his oasis from the invading sand the Fezzani puts a mat into the ground on the border of his garden, letting it protrude about 2 feet. As the sand never drifts higher than that, he can, with judicious management, deflect the direction of an entire dune; but as soon as this work is neglected the sand will advance.

The oases of Yat, Yeggeba, Kauwar, and Agadem, which we passed successively on our way south, are all protected by ridges of hills to the last, as are the water-holes of Zo Gana and Dibbela. Only Kauwar is inhabited now, though I found stone implements in all of them, and even Barth found small villages there.

South of Gatrun the desert is, no doubt, of very ancient date. Immediately south of Tejerri, the most southern village of the Gatrun oasis, the sandy desert disappears, and great serirs, large fields covered by fine gravel, slowly lead up into a succession of broad valleys and ridges of an unsurpassed wildness. Nothing but endless stretches of dark gravel, dark whale-backed hills with forbidding valleys between, with never a sign of life. Not a blade of grass nor a single shrub varied the monotony of this stony desolation.

The road reached the highest point in the pass which leads through the Tummo mountains or El War. These hills belong to a ridge which runs parallel to the valleys of Fezzan from west to east. Towards the north-east, from where the wind comes throughout the year, the mountains are covered by a black coating, which gives them a very wild appearance. Equally all the rocks along the road show the same dark covering to the windward. This formation has been observed in Africa, North America, and Central Asia, and always occurs in a climate where rain is scarce or unknown.

The dark brown covering of the Tummo mountains contained oxides of iron and manganese. The stones had a hard and solid appearance, but a slight knock broke the covering, and the stone underneath fell away in powder. I found several pieces of sandstone lying in places where the wind blew all round them, where the surface mantle had formed a regular cup, out of which I could pour the loose sand. To the south the Tummo mountains show the same brownish colouring as their surroundings. Of some boulders lying in the road only the hard black coating remained.

According to Prof. Walther, this formation is caused chiefly by the humidity of the air and the intense heat of the sun. In fact the wind from the north-east comes from the sea, and the temperature rose regularly to 125° Fahr. in the shade of our tents over mid-day.

SALT LAKE NORTH OF BORNU.

SALT LAKE NORTH OF BORNU.

South of Tummo the hills became fewer, and the wide serirs changed into sand wastes, where here and there a solitary hill showed with its face to the north all black. Past the oases of Yat and Yeggeba the road emerged into open country to the north end of the mountains of Kauwar. The amount of water in this oasis is remarkable, and as it scarcely ever rains it must come from some distance. In some places the ground was wet from the water which percolated right to the surface. At the south end of the depression there are large open holes, where the water can be seen continually bubbling up in a clear stream.

Kauwar is famous for its salt, which is found everywhere in great quantities in the surface of the ground, especially near the village of Bilma. Though in smaller quantities, such deposits of salt are found in many places throughout the sandy desert, in Fezzan, and again on the northern border of Bornu. During the process of chemical decomposition carried on in the desert by wind and temperature, the various salts are drawn from the rocks, and then carried away over the desert by the wind till they come to rest in some depression. In the course of time the salt accumulates till it appears on the surface as it does in Fezzan, in Kauwar, and in the saltings north of Bornu. In every one of these places the salt only lies on the surface, as the water at a small depth already is quite sweet.

To the south of Bilma lie more sand-dunes, and the last hills of the Kauwan ridge soon disappear in the yellow sea. The whole country as far as the eye can see is covered by immense ridges of sand running like the waves of an angry ocean in long parallel lines to the far horizon on either side. Our caravan left nearly fifty camels in these dunes as we climbed and descended ridge after ridge between Bilma and Agadem. Then we came into the open plain of the Tintumma, and passed imperceptibly from the sandy desert into the African bush as we neared Ngigmi and the depression of Lake Chad.

Most of the water-holes immediately north of Chad have dried up during the last few years, and the desert has appreciably advanced towards the boundary of Northern Nigeria. This advance of the desert has followed immediately on the depopulation of the country, and not on any change of the climate.

The people I passed along the road, Arabs, Berbers, and Negroes, all bear the impression of the cruel country that surrounds them and forces them to fight for their very existence. With the exception of the Fezzanis, who seem to have resigned themselves to their fate with a good grace, they are cruel and treacherous, and mostly cowards.

The Arabs are divided into traders and nomads. In all probability the nomad Arabs lived in north Africa long before the Mohammedan conquest, and a great many of them must have been absorbed by the Berber element. The nomad Arab is the best ally of the destructive desert, and his presence has been a curse to North Africa. Formerly

kept in order by the ruling races, they broke loose, and began to waste the land when the Mohammedan conquest swept over North Africa. The native Berber regarded the Roman monuments with veneration, and left them untouched. The Arab destroyed them wantonly under cover of religious fervour. To annoy a temporal enemy, he would cut down palm-groves that took fifty years to grow, and filled up all wells that had been held sacred for centuries.

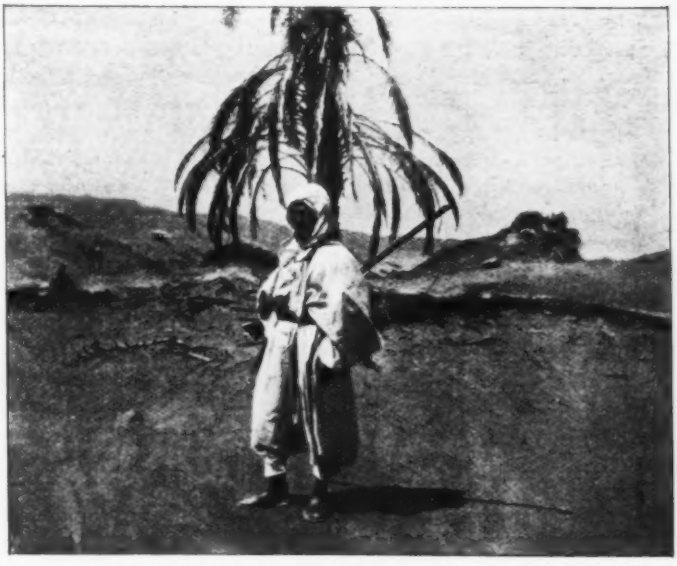
A number of these tribes live along the Wadi Shiati, the Megarha, the Hassauna, the Salike, the Hotman, and the Zuwaid. The Wuled Sleiman from Borku forced the French commandant, with whom I was travelling back to Bilma, to reinforce, and took two thousand camels with their charges from the Asbinawa who had come to Bilma for salt. It was this tribe which wasted Fezzan before the advent of the Turks, who defeated them and drove them southward.

The Arabs who carry on the trans-Saharan trade live mostly at Tripoli and Ghadames. The Murzuk traders come from Sokna and are Berbers. They are naturally not pleased with European advance, but have a great capacity for adapting themselves to circumstances, and I believe that they will naturally become the middlemen between the European and the negro whom they understand extremely well. In character and appearance they have little in common with the Beduin. They are far less fanatical and of a very peaceful disposition, desiring above all to be left in peace.

Berbers, descendants of the old Lybians, I met in the farming natives at Gharian and in Fezzan, and as the Tuarek, the nomad robbers of the Sahara. The Fezzanis have become so mixed through the continuous wars and the great influx of negroes caused by the slave traffic that they can scarcely be described as Berbers. Every race from Egypt to Timbuktu, and from the coast to Chad, has left its mark on the Fezzanis around Murzuk. They are of a most cheerful disposition; and while the desert covers up their gardens and they are forced to migrate to the coast, they sing and dance, eat dog-flesh, and drink much palm-wine in total disregard of the Prophet's teachings.

Tuareks I met in Fezzan, and the Asbinawas, their peaceful cousins from Aïr, at Bilma. The Tuareks in Fezzan belong to the Asgar tribe, and have lately been driven east by the Hoggar; their headquarters are at Ghat. Since the time of Duveyrier the Tuarek has been regarded as the knight of the Sahara. The murder of Miss Tinne and the fate of the Flatters expedition have shown that the Tuarek does not even know what honour is. His courage is that of a dog. He will never attack except at night and when in superior numbers. I was followed from Murzuk by twenty-five Asgar Tuareks, and at Tejerri they attacked me during the night. A few shots kept them off at night, and in the morning I fought them, and after some hours drove them away with four dead and the loss of twenty-five camels.

THE DEPRESSION OF LAKE CHAD. A BUDDUMA CANOE.



A BEDUIN SHEIKH.

It is their curious social life which forces the Tuarek to raid caravans. The mother has all the rights over the children, and all the property is in the hands of the women. To marry a wife a Tuarek must pay a large sum to the bride and her mother, and the only way to get the necessary wealth open to the ardent lover is a successful raid, for his ordinary occupation, camel-farming and carrying loads for the traders, brings him hardly enough profit to live by. The sworn enemies of the Tuareks are the Tubbus, and the two raid each other continually, with the result that oasis after oasis gets cut down and disappears.

In the oasis of Bilma I have seen large palm groves cut down by the Tuareks because the people had been prepared for the attack and had taken refuge in their rock castles.

The Asbinawas, the Tuareks from Aïr, on the other hand, are of a more peaceful character. They trade with the Bilma salt which they barter each year from the Kauwar people for Manchester goods and millet, for the people of the oasis are not allowed to grow their own corn. When at Bilma we saw a caravan of over eight thousand camels arrive from Aïr. As the oasis grows scarcely any food for the camels, the Asbinawas load their animals up with grass, which they bury in the sand along the route, to dig it up and use it on their return.

Negroes there are everywhere on the route from Tripoli—in fact, the time is not so far off when they lived all along the Mediterranean. On the North Coast one meets Hausas and Kanuris in great numbers. Freed slaves mostly, and stranded pilgrims on their way to Mecca or waiting for an opportunity to return south.

Phasania or Fezzan, which in the times of the Romans was called the borderland of Æthiopia, has always been in close contact with the negro countries. For a long time Fezzan was even a province of the negro kingdom of Kanem or Bornu, and we know of one Bornu chief who sent large slave colonies to people the different oases, to work the salt mines, and facilitate the passage of caravans. The Devade, as the negroes in north Fezzan are called, and the holy men of Gatrun, are undoubtedly Kanuris. The Tubbu Reshade, or the mountain Tubbus, whom I met at Tejerri, are negroes with a strong Berber element. Though black in skin, and sometimes with flat noses and negro physiognomies, they are much lighter built than their southern neighbours, and have many characteristics of the Berbers. They are as treacherous as the Tuareks, and more dangerous, as they are much hardier. The Tubbus of Kanwar have all the features of the Kanuris.

The political aspect in the vilayet of Tripoli has much changed in late years. Many discontents and bad characters have crossed over the borders from Egypt and Tunis. The fanatical fervour of these people was often only an excuse for their general dislike of order and justice. The vilayet has profited little by these new-comers, whose habits have already given the Turkish authorities much trouble.

With the end of the slave trade Fezzan has, I have already said, lost its last source of income. At present the slave traffic across the Sahara can be called extinct—at any rate, on the routes from Bornu and Kano to the North Coast. The extent of the former slave trade can be slightly estimated by numberless skeletons which one meets along the caravan routes south of Murzuk. The unnecessary cruelty of the Arab traders who drove their flocks of slave children over the waterless roads can be understood when one bears in mind the fact that slaves had become so cheap in Bornu and Kano that the Arabs could afford to lose 80 per cent. of the children on the road and still make a profit on the remainder.

One has heard much of the Senussi sect in late years, and on my journey I met many members of the sect. Throughout Tripoli the sect has in past years lost greatly in numbers. I found Senussi sauwyas, or meeting-houses all along the route, and with the exception of one place, I was on the best terms with the members. That one place was Misda, where I was nearly stoned while making a sketch of the Sauwya. But then it had not rained at Misda for twelve years. I was assured time after time that all the Senussi wished was to be left in peace to study and follow the precepts of the Prophet. Nearly all the towns and villages I passed sent a yearly contribution to Kufra, the headquarters of the sect. Some Fezzani traders told me that they paid the annual contribution as a kind of insurance money. The Tubbu Reshade, who belong to the Senussia to a man, and at the same time are the most feared robbers on the road, will always respect the loads of a member of the sect.

There is every hope that the advance of the desert may be stayed during the next few years. With a strong Government in Tripoli, such as the new Turkish constitution promises us for the future, the people in Tripoli and Fezzan will gain confidence in themselves and the wealth of their own country independent of the trans-Saharan trade, which at best was only an artificial source of income, and did the poor people more harm than good. Already the influence of the young Turkish element during the time of Redjel Pasha has made itself felt throughout the country.

With the French garrisons in Aïr and Bilma the old trade routes from Kano and Bornu will be reopened, and the oases will once more be held by men against the desert, when the caravans from Aïr, Ghat, Bilma, Tibesti, and Borku will work their way to the great European market, which our new railway will open in Kano.

The PRESIDENT (before the paper): Mr. Hanns Vischer, whom we welcome here to-night as our lecturer, is a native of Switzerland. He went out to Nigeria some years ago in the first place as a missionary, but he made himself so useful to the administration there that they persuaded him to become an official of the Niger Protectorate. For several years, therefore, he has been in the service of the British Government, and quite recently he has been appointed Director of Education to Northern Nigeria. But he has always taken a great interest in exploration, and on one occasion when he was intending to return home on leave he determined to try

to cross the Sahara northwards, especially with the view of endeavouring to explore the Tibesti mountains—a region of Africa very little known, that stretch 700 miles or so north-west from Darfur. He was, unfortunately, unable to carry out this expedition, but still hopes to do so. His last journey, which he is going to describe to-night, was from the north, southwards across that great wasteland, and I am sure we shall all find it full of interest from a geological, ethnological, and archæological point of view. The number of routes throughout the world, the traversing of which involves great personal danger to the explorer, is becoming every decade less and less, fewer and fewer. The route to be described to-night is one of them, and I am tempted to say that happily some remain. At all events, we, sitting here in this comfortable hall—or perhaps I should say this tolerably comfortable hall—feel the advantage of the existence of regions where adventure is still possible. But I will not keep you from taking what I may describe as "our part" in the adventure in the Sahara, and will at once call on Mr. Vischer to be kind enough to deliver his lecture.

Mr. H. Weld Blundell: One of the most interesting parts of the lecturer's paper seems to me to be that which had reference to the slave trade. He mentions the points where you could almost see the road by the number of skeletons that were visible. That great slave trade was headed off from that road through the vigilance of Europe, and was driven to the eastern road through Kufra to Benghazi. When I was at Benghazi, two caravans came every year with 1200 slaves each, and, as according to local information about one in three survived, you may take it 4000 people were left on that desert twice a year. Many of these slaves were brought to the harbours of the Cyrenaica, and distributed to various ports in the eastern Levant. The Senussi sect, that the lecturer mentions, have their convents and settlements all over the Sahara desert. All along the north coast of Africa, starting on the other side of the bay of Sydra, they have a great number of these convents, or sauwyas, some of which contain over 300 slaves, tilling the soil and working for them. At Siwa, when I was there, the heads of the sect reckoned that they had in different parts over 7000 slaves in their possession. Not being allowed to ship the slaves across the Mediterranean, the last dodge for getting them over to Constantinople and Smyrna was for the caravan leaders to marry two or three hundred of these slaves each, and smuggle them across as their wives. I congratulate the lecturer very much upon this most interesting journey, which has not been done, I believe, since Dr. Barth, and opens out an immensely rich field both for the ethnologist and the archæologist. The Tuaregs, that have been always such a mysterious force in the desert, are also a most interesting nation, and are supposed to be among those that have the most legitimate right to be considered the representatives of the ancient Libyans, the Temahu who are depicted on the monuments of Egypt as having invaded it sixteen centuries before Christ.

Prof. Wyndham Dunstan: I have been very much interested in hearing this excellent account by Mr. Vischer of his journey across the Sahara. As we all know, this was one of the great routes by which the produce of the Western Sudan reached the markets of Europe, and having heard so much of interest from Mr. Vischer, one wishes to know more; and I think many besides myself would like to hear what has become of that caravan trade; how much remains and how much more is likely to be taken in future by the Niger route on the other side. We have already created a very large shipping trade with West Africa, and it is to our interest that this should be developed, and that the products of what we now call Northern Nigeria should come by the Niger to the port of Liverpool. Of the very large amount of produce that used to come by the caravans across the route which has been described to-night, I believe a certain proportion still comes that way, including leather and ostrich feathers.

Mr. Vischer: Trans-Saharan trade may be called extinct at the present day, as I showed in the course of my paper. There are two roads from Northern Nigeria to the coast and Tripoli—one from Kano by Tinder and Aïr to Ghat and thence to Tripoli, the other from Bornu *viâ* Bilma and Murzuk. Owing to the continual raids from Hoggar Tuareks and Tubbus, these roads are quite unsafe. Comparative safety for passing caravans can only be expected after the country has been repopulated, and that will take a long time. Long before that the Arab traders, who for generations past have carried on the commerce with the people of Nigeria, will have come south, where their natural ability will make them the middlemen between the European trader and the negro. I feel therefore convinced that our new (Nigerian) railway will provide the markets for all the Southern Sahara countries, Aïr, Demageram, Kanem, Borku, Bilma and Tibesti, and that, while furthering this, the prosperity of the people will indirectly contribute towards the driving back of the desert from our borders.

The President (after the paper): The extremely modest lecture which we have listened to to-night hardly gave the impression of confirming what I said in my opening remarks as to the danger of this journey. I hope no one will be deceived by that modesty, and will believe me when I say that it is really an extremely dangerous journey which Mr. Vischer accomplished. This fact is confirmed in rather a striking way to-night. We have nearly always a large number who wish to take part in the discussion, whilst to-night there have been very few. Still, when we remember that there have only been two or three Europeans who have travelled this road during the last half-century, it is not very surprising that none of them should be present in order to discuss the question with Mr. Vischer. The lecturer has very wisely concerned himself, not so much with his own personal adventures, but with the many interesting problems which are brought up for solution in this interesting country. He has told us how the sand is constantly encroaching on the oasis, and how this encroachment is increasing because of the diminution of the number of inhabitants. But if we look back to prehistoric times, we must admit that there was a period when there were no human beings in this district. At that period, then, either the climate must have been much better, and there must have been much more vegetation, or else when the first men came into that region they must have known better than the present inhabitants how, not only to stop the encroachment of the sand, but to win back from the sandy desert places fit for cultivation. It seems to me that this latter hypothesis is very improbable, and therefore in prehistoric times there must have been in that land a very different climate to what now exists. The fossil trees alluded to seem to confirm this view. I think what the lecturer says about the inhabitants not being able to keep the sand back is perfectly consistent with this state of things—with this view of there having been a better climate in prehistoric times. But still, it has raised the very interesting question whether the climate is getting better or worse; whether this struggle is becoming more or less difficult. If more difficult, one would feel inclined to say that it would be better to give in. Hence we see there are many interesting scientific questions to be dealt with in this region, but for them to be thoroughly dealt with needs careful scientific observation extending over many years. But for observations of this kind, pioneer explorers like Mr. Vischer must have opened up the road and made it possible for travellers. In bringing this meeting to a close, I am sure I may, in the name of every one here present, thank Mr. Vischer most heartily for his pioneer journey through this most dangerous and difficult land, and also for the extremely interesting way he has described it to us to-night. I beg to thank him in your name most sincerely.

MAN AND CLIMATIC CHANGE IN SOUTH AMERICA.

By ISAIAH BOWMAN.

From time to time there is reported the finding in the arid parts of South America of evidence indicative of climatic changes within the human period. As similar evidences are repeatedly brought to light in other regions, notably Asia and northern Africa, and are of wide current interest, it will be important to see what the rank and quality of the South American observations are, and what is the degree of conclusiveness which they warrant. Further interest attaches to these examples from the southern hemisphere, because the evidences are not in any important degree derived from scanty and ambiguous historic records from a remote past, but consist of physical objects and facts observable by any one to-day; and once the facts are accurately observed a few postulates can be admitted even by the most radical student, and of these it appears to the present writer that the one pointing to pronounced climatic change since the occupation of the region by man is by far the most reasonable. The admission of this position at the outset will enable the reader to take, if he chooses, an antagonistic view, and thus perhaps the more thoroughly test both evidence and conclusion.

Three sets of observations will be examined. The three are in distinctly different localities in the arid portion of western South America; they are evidences of totally different sorts, and could not therefore have been misinterpreted by the suggestions of one observer to the other; and the observations are distinctly separate in time. The first set of observations we owe to Darwin, who, in that scientific classic, 'A Naturalist's Voyage Around the World,' brought to light certain observations on ruins and on changed conditions of human habitability in Chile, and with characteristic freedom of thought he at once entertained the theory of climatic change. The second set of observations here considered is by Moreno, who has for many years gathered data of this sort and who, in 1901, in an article entitled "Notes on the Anthropogeography of Argentine," * set forth the conclusion that the climate of north-western Argentine had undergone so marked a change as to affect the population and exclude them from regions formerly habitable. The third set of observations was gathered by the Yale South American Expedition of 1907, and pertains to the Lake Huasco region east of Iquique, an enclosed basin in the Maritime Andes. The observations will be discussed in the order of their publication.

Darwin writes † that the most perfect ruins he observed were

* *Geog. Jour.*, vol. **18**, pp. 574–589.

† John Murray, edition of 1890, pp. 341 *et seq.*

the Ruinas de Tambillos, in the Uspallata pass, where occurred small square rooms huddled together in separate groups, with some of the doorways, formed by a cross slab of stone only about 3 feet high, yet standing. The houses when in condition must have been capable of containing a considerable number of people. The location of the ruins on the pass suggests that they may simply represent a halting-station on one of the Inca roads, and such is the tradition. Taken by itself this evidence is therefore inconclusive. It harmonizes with the thought of climatic change as affecting man, but does not establish it.

In other parts the evidence is stronger. Ruins were observed "where it does not appear *probable* that they were used as mere resting-places, but yet where the land is . . . utterly unfit for any kind of cultivation." In the ravine of Jajuel, near Aconcagua, where there is no pass, Darwin "heard" of remains of houses "situated at a great height, where it is extremely cold and sterile." From this he was "inclined to speculate on the probability of a small change of climate." In the Cordillera of central (then northern) Chile ruins of old Indian houses were reported numerous, and in them were not infrequently discovered bits of woollen articles, instruments of precious metals, and heads of Indian corn. Of course the climatic control this suggests is not that of changing temperature which formerly made the higher tracts more inhabitable, for many of the upland dwellers of to-day inhabit lofty and bleak situations. The significant fact is that many of them were in places where the land to-day "produces absolutely nothing, and, what is still more extraordinary, where there is no water." The evidence was gathered in part from "men who had spent their lives in travelling through the Andes," and that the houses were formerly used as places of refreshment was affirmed by "the . . . people of the country." No one need point to the weakness of the argument as above outlined, for that weakness Darwin clearly suggests, less by the directness of his final conclusion than by the care with which he reports the source and the exact quality of the evidence.

Regarding Darwin's personal observations there will be little doubt. These were made at Punta Gorda, south of the Copiapó valley, and an exacter appreciation of their value may be gained by noting the position of the locality with respect to the southern edge of the desert of Atacama. The practically rainless desert begins some distance north of Copiapó at Paposo, 25° S. Between this locality and Valparaiso there are occasional showers, and although they are very light and uncertain, they measurably increase the resources of the inhabitants to-day. Even in the vicinity of Valparaiso there is very light rainfall, only about 12 inches a year. Now, further north, in the more completely arid desert of Tarapacá, a slight favourable change of climate would still leave the climate so arid that it might not visibly affect the population capacity of the land; on the

other hand, if the rainfall were only slightly increased in that border region, from Paposo to Valparaiso, where the desert grades off into the well-watered lands, and where there is already *some* rainfall, the region might—indeed, must—by that fact become more habitable. While Darwin does not point to the critical locations with respect to rain-belts of the points at which his observations were made, he does suggest the effect in the region of a change from the present condition of one shower in two or three years to two or three showers a year. It would mean just that slight concentration of water in springs and rills which makes the support of a few families a possibility in favoured localities.

The ruins at Punta Gorda are situated in a most conspicuous and defenceless position at the bottom of a broad flat valley. "There was no water nearer than 3 or 4 leagues, and that only in very small quantity, and bad; the soil was absolutely sterile; I looked in vain even for a lichen adhering to the rocks. At the present day, with the advantage of beasts of burden, a mine, unless it were very rich, could scarcely be worked here with profit. Yet the Indians formerly chose it as a place of residence!" In looking about for an explanation, it is evident, from Darwin's statement concerning the observations of Gill, a civil engineer at Lima, that he is much impressed by Gill's conclusion that the greater portion of the land now incapable of cultivation, but covered with Indian ruins, was reduced to this state by neglect of the water-conduits or their breakage by subterranean movements. A case is cited of the bodily diversion of a stream by crustal deformation, probably associated with an earthquake, and such action might cause an irrigated tract to lose its fertilizing stream and revert to its original desert condition. This is undoubtedly the case in many instances, but it very obviously does not apply to Punta Gorda in a valley of pronounced grade even to-day, and one not capable of being irrigated at this precise locality from any higher source. While Darwin's observations, as a whole, are neither extensive nor conclusive enough to satisfy the hypothesis of climatic change, some of them point with conviction to that hypothesis, and all harmonize with the conclusions based upon those different observations and methods of analysis next to be reviewed.

Moreno bases his conclusions of climatic change upon evidence gathered north of Mendoza and in north-western Argentina generally. A century ago the small lakes of Guanacache, between San Juan and Mendoza, are reported to have been much more extensive, and to have been navigated by the Indians as Lake Titacaca is navigated to-day. Moreover, in the Andine gorges he has seen extensive ruins where to-day life is extremely difficult or impossible during a great part of the year, and extensive irrigation works where to-day one could not possibly find a drop of water, "showing that the climatic conditions

of these regions have changed, and that the waters must have diminished."

Further instances are cited from north-western Argentina, whose physiography is characterized by a series of enclosed basins and basin-like valleys. All of it is arid or semi-arid, and is described as having a desert-like appearance similar to many parts of our own south-west or of northern Mexico. "The vegetation where irrigation has not reached is poor, and the predominant tree in the lower plains is the algarroba or carob tree. In the highlands volcanic rocks predominate, and the scenery now seems that of a dead world. . . . These dreary broken lands are apparently unfit for permanent human settlement; but that has not always been the case." In every part of the plains, valleys, gorges, and summits, proofs are alleged to have been found that the region was once inhabited, the climate then being milder and more temperate. Numerous rock hollows have been observed in which corn and algarroba beans were once pounded. Burial-grounds occur everywhere, their accessory contents displaying great skill in pottery. Stone hammers and axes are common, besides objects in copper and gold. Animal forms are carved in stone, sometimes in hard basalt. These evidences are most numerous in the valley near the town of Catamarca, from the old settlement of Chumbicha at the southern end of the valley to the Pucara at the base of Mount Aconquija. Here is a valley in which there was once a continuous line of villages and busy towns bordered by massive mountains, and defended at the extremity by the military posts of Chumbicha and Pucara. In another valley to the north are the remains of walls and agricultural grounds so extensive as to indicate, it is asserted, that the population formerly numbered "tens of thousands." "To-day the waters of the valley are scanty and used only by a few descendants of the natives, possessing only a few goats and a little maize. In former times rains must have been frequent and water more abundant than it is to-day, as there are still visible small grounds in the rocky slopes which have been cultivated by natural supplies and not by irrigation, which would have been impossible."

To the west of the dry abrupt chain of Ambato is an extensive old lacustrine basin of 5000 square miles bounded by mountains to north, east, and west, and by low hills on the south. Moreno visited the foot of the eastern side, and says positively that the water-supply existing there to-day is hardly sufficient for the needs of the small villages, and quite insufficient for the former large population. The remains of the ancient villages extend in every direction, even to the centre of the old lake, now reduced to salt deposits flooded during the rainy season. The settlements are believed to have encroached on the lake during the process of evaporation. Specimens of ancient industry, old settlements, and burial-grounds are found to-day in districts where now it is necessary to carry water for drinking purposes. Only the north-east

corner of this once extensively cultivated basin is cultivated to-day. At Antofagasta de la Sierra is a barren landscape where a few small streams empty themselves into a little lagoon at the foot of the two recent volcanoes. The climate only admits of the cultivation in patches of a sort of clover. "In the time of former settlements there were cornfields and irrigating channels, while among the ruins of the town, and in the black lava, were discovered foundries and small melting-pots and broken casts for beautiful bronze disks."

Reviewing the evidence outlined above, we note that the first item is a legend—a report that a small and now unused lake was once navigated. Without any suggestion of the authenticity of the legend, or any evidence of its having been tested, we are obliged to record it merely as belonging to that large class of neutral evidence which neither contravenes nor strengthens the supposition of climatic change. The general statement that follows, to the effect that the climate must have changed because old settlements, as attested by numerous ruins, were located where now not a drop of water is to be found, only raises the question as to the possibilities of water transportation and storage in the valley. The question is partly answered in a later paragraph, where it is noted that small anciently cultivated tracts are visible, which must have been furnished by natural supplies, because irrigation would not have been possible. That is to say, actual rain must have fallen upon these unirrigable patches of land, or very obviously agriculture could not have been carried on. In the absence of detailed evidence of the water possibilities of specific areas, we can only assume that Moreno's judgment as to these possibilities is or is not to be trusted. As he is a native of Argentina, has travelled the arid districts frequently, and knows them intimately, the assumption seems fair that he is accurate in these generalizations affecting limited areas whose water-supply is easily capable of fairly accurate appreciation upon brief study. Furthermore, the extremes are so wide—of relatively dense populations once inhabiting basins that to-day support but small villages, and in which water must be carried for the miners—that the limits of error in estimating the water-supply would seem to fall well within the actual hard facts of observation upon settlements. Furthermore, among these distinct basins and restricted valleys each is a law unto itself. No far distant source can be appealed to as upon a flatter tract where interior basin drainage is not the rule. It is certain that the settlements must have been supported by the water-supply of that particular basin in which they are found. Neither can it be argued that these settlements in an ancient mining region may mean artificial support by other towns that depended upon the basin populations for metals. For the observed facts are not alone those of mere settlements, but those indicating agricultural activity on a corresponding and now impossible scale.

The route of the Yale South American expedition of 1907 was from Pica, one of the larger oases that occur along the western base of the Maratime Andes back of Igwigoe, eastward across the Andes to Llica, in western Bolivia. In the course of the journey some time was spent in the Lake Huasco basin, which lies at the western foot of the great Sillilica range, a line of lofty volcanic peaks that surmount the plateau-like western Andes. Opportunity was thereby afforded to ride around the southern end of the basin, observe the now elevated beaches about its margin, and to discover what were considered to be signs of occupation of the basin by man when the lake waters were at a much higher level than now. All locations referred to in the following description may be identified upon the map (Fig. 1). The basin is about 14 miles long (north to south) and 8 miles wide (east to west). Upon its very flat floor a salt lake now occurs whose dimensions are much more restricted than that of the basin—a lake of ragged outline bordered by salt-encrusted plains. About the margin of the basin alluvium has everywhere been washed in, but to a less degree upon the south side than elsewhere. Upon these alluvial fans and *débris* slopes grass grows in a few patches where natural irrigation from springs obtains, while upon the drier portions tola bushes occur. The less salty portions of the plain bordering the lake likewise bear a certain quantity of succulent grass utilized by the vicuña and guanaco that in great numbers come down from the higher portion of the Andes to graze upon the short grass during the height of the winter season (Figs. 2 and 3).

Upon the west side of the basin, and at the base of the steep scarp that there forms the margin, are a number of springs of clear water, fed from the higher portions of the plateau to the west and north-west. Upon them the trails of the region focus. A number of corrals have been built about some of them, and in one case several stone and mud huts, now no longer used, are to be found. In the south-eastern, and again in the south-western corners of the basin, other stone corrals occur, not, however, where water is to be found to-day, but merely beside the trail, the one (A, Figs. 1 and 2) at the mouth of a gorge in an angle of the gorge-wall sheltered from the wind, the other (B) at the foot of a scarp, where similar protection is afforded. From A to B is about 6 miles, and the best evidence to be considered lies between these two points. It is in the form of old trails, corrals, and stone walls now in ruins. These are about 150 feet above the floor of the basin, and to a notable degree their position corresponds with that of a low terrace of that old lake, ancestral to the present one (see Fig. 4). Their most distinct and quite unmistakable occurrence is for about 3 miles, beginning near A and running toward B. In this stretch the old corral at Huasco Ligeltz is most clearly defined. Here one may see a once well-worn but now abandoned and rather faint trail just outside

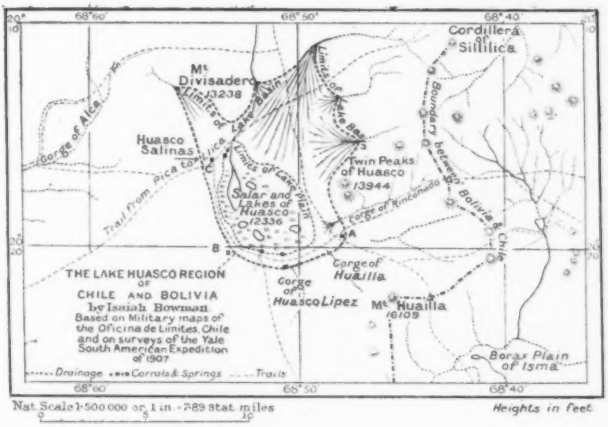

68°10'
68°50'
68°40'
20°
Cordillera de Sillilica
Mt Divisadero 13238
Limits of Lake Basin
Boundary between Bolivia & Chile
Gorge of Alca
Huasco Salinas
Trail from Pica to Llica
Twin Peaks of Huasco 13944
Gorge of Rinconada
Salar and Lakes of Huasco 12336
THE LAKE HUASCO REGION OF CHILE AND BOLIVIA by Isaiah Bowman Based on Military maps of the Oficina de Limites, Chile and on surveys of the Yale South American Expedition of 1907
Gorge of Huailla
Gorge of Huasco Lipez
Mt Huailla 16109
Borax Plain of Isma
Drainage
Corrals & Springs
Trails
Nat. Scale 1:500 000 or 1 in. = 7.89 stat. miles
Heights in feet

FIG. 1.

The military maps of Chile, which have been a partial source of material for this map, do not indicate the topography. For this reason the limits of the Huasco basin, as here defined, are only approximate. On the west these limits coincide with a 1000-foot scarp of marked rectilinear quality and of greater extent than the lake basin. On the north the limits of the basin are the heads of a series of great alluvial fans, miles in length and far higher than the highest strand lines, the largest one toward the north being nearly 1000 feet above present lake-level.

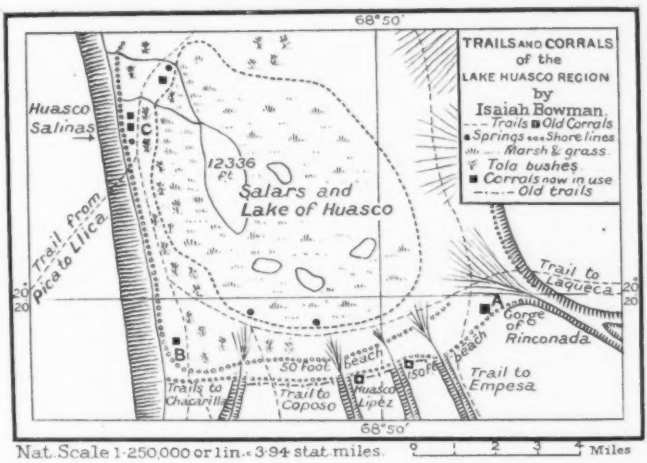


FIG. 2.

This large-scale map has many inaccuracies comparable with those of Fig. 1. They are due to the limits of time for making field surveys and to the narrow limits of knowledge as expressed on best available maps. The map at least portrays with reasonable accuracy the trails and corrals and their space-relations, together with their relations to the old lake-levels. The scarp on the left is artificially straight, nevertheless it is rectilinear to a highly conspicuous degree with few important exceptions.

(south) of a stone wall, or, it would be more accurate to say, a line of stones. Sand has been drifted over the old trail, and it is washed out in places, while the line of stones has crumbled and been somewhat displaced by the accidents of the weather—frost, changing temperature, and wind. Yet both the trail and the line of stones are distinct and unmistakable, as Fig. 4 suggests. The photograph brings out the most conspicuous and important quality of the feature—the contour-like trend of the line of stones. The line curves out and in gently, thus roughly corresponding both to the vertical position and to the horizontal irregularities of the edge of the old water-plane. Here and there along the trail are two features common to all the accustomed trails of to-day —*signos del camino* and stone corrals. The former are heaps of stones, the accumulations of many years, to which each passer-by contributes. Their functions are various: they point the way (hence the name, "sign of the way") in those parts of the route where sand-drifts occur; are supposed to be a preventive of drought if erected at the sources of the streams; and are, in a sense, altars, when erected upon passes, where offerings of llama, wool, millet, and, in these latter days, candles and crosses are made. In still other cases they are an index of good fortune, and the addition of a stone to the heap is supposed to bring the traveller good luck. They are to be found everywhere along every trail—one is almost never out of sight of at least one of them—and are often of prodigious size, 10 to 14 feet in height, and 40 or 50 feet in circumference.

The stone corrals along the line of the old road are invariably erected where stream-channels cross the trail on their way down the gentle slope that descends to the margin of the basin-floor. The upper part of one side of such a channel shows in the foreground of Fig. 4. The identity of the corrals is unmistakable, even in their present condition, with the stones for the most part fallen away, only an occasional wall remnant now being visible to indicate the nature of the accumulation and the outlines of the once occupied corral. So far as shelter goes the position of these dilapidated corrals is quite unreasonable, for they are exposed to the full strength of winds from every quarter. The inference seems reasonable that such an exposed position at this altitude (12,000 feet), where the night-winds from off the snow-capped Sillilica range are exceedingly bitter (3° Fahr. minimum, night of May 13, 1907), can only be explained by an attraction that proved stronger than the disadvantage of full exposure to strong cold winds. It cannot be argued that, because other corrals in similarly exposed situations are frequently to be found, these offer no exception to the rule, for exposed situations everywhere are chosen only through lack of sheltered ones; and in this case the distance to shelter was in one direction 2 to 3 miles, in the other 4 to 5 miles. The location was determined, it seems reasonable to suppose, by a water-supply associated with those channels

on the margin of which the corrals occur. A subsidiary fact of great value is that, when the lake waters stood at this 150-feet level, the now grassy areas on the west side of the lake, and that now attract passing caravans, were then covered with water, and, indeed, along that very margin which is now attractive because of water and pasture. In place of water and pasture there was an abrupt untraversable declivity, which descended steeply below lake-level for at least 100 feet. Similar conditions prevailed elsewhere, except in the north-western corner of the basin and about its southern end. Here, then, was one of the few places where *accessible* water and probably pasture were to be found. This fact harmonizes so well with that of the trail, with its margining line of stones running contour-like about the margin of the basin near

FIG. 3.—THE BASIN OF LAKE HUASCO VIEWED FROM ITS WESTERN MARGIN.

Directly behind the camera is the 1000-foot scarp of Fig. 2. In the foreground is a *débris* slope covered with tola bushes. Beyond this zone is the grass-covered and salt-incrusted plain from which the lake waters have been recently withdrawn. The dark band in the middle distance is Lake Huasco itself. The twin peaks of Huasco are in the background and the gorge of Rinconado is in the extreme right background.

an old terrace, that we seem obliged to accept this as evidence of the use of the trial when the lake stood at a level 150 feet above its present one. The use of corrals in a position otherwise so inhospitable seems likewise certain at a time when the tributary streams now represented by dry channels (save when the snows are melting or a rare thunder-storm occurs) were a dependable source of supply.

Just how absurd the positions of the old corrals would be if such old conditions of water-supply are not postulated can best be shown by pointing to the advantages of the accustomed trails of to-day, advantages which only appeared with the withdrawal of the lake waters to their present position. The lines of the used trails, as expressed in Figs. 1 and 2, clearly show that for every possible direction one would wish to go from any spring the existing trails are most direct. They cut across the head of the basin, thus saving the *détour* of the old route.

At the present time plenty of grass and water are found along the western edge of the basin; none whatever is found along the old route. The transient occupants, and their fires, in existing corrals, are at least partly sheltered from the wind; the old corrals are fully exposed to strong cold winds. Neither can the low terrace in connection with which the corrals and stone line occur be invoked as a cause of location, for it is very faint, and offers no advantages over the rest of the relatively gentle slope upon which it is built. It indeed seems as if every reason one can assign for the building of a corral in the lake basin is violated by the old corrals in their present position. So absurd a position cannot be thought to have been chosen by a people who had advanced, even at the time the old trail was used, to the point where the llama was domesticated, and some travelling, and undoubtedly therefore some trading, was practised. It seems reasonable to argue, therefore, that the position is only absurd because the physical conditions have changed since it was maintained. When the lake waters fell in response to the ensuing drier climate that has continued up to the present, directer routes were offered, and better camping sites, where water and food were combined with at least partial shelter. The old routes were then naturally abandoned, and now constitute fossil roads as indicative of ancient human affairs, as the contemporary fossil beaches with which they were associated are indicative of changed physical conditions.

A phase of the change from the old to the existing routes is marked upon the stony beach that stands 50 feet above present lake-level on the west side of the basin (C, Figs. 1 and 2). The top of the beach is well criss-crossed by old and now somewhat faint llama trails. These have a peculiar braided pattern everywhere, an unmistakable design that is caused by the irregular march of this erratic beast, as it wanders this way and that from the general route. Not even a vagrant llama would follow the route to-day because of the absence of food as *versus* its presence on the alluvial slope and basin floor just below. Much less would such a course be followed by a caravan. The consideration of changing lake-level having temporarily forced the road to take this high level, in response to cyclic climatic changes of a few years' duration, is excluded because these fluctuations are but a few feet in value at the most, as marked by the marginal saline deposit that the waters form, and as indicated by the fact that the now used corrals, huts, and trails are at various intermediate levels between the 50-feet beach and the basin floor. While one must admit less certainty in the case of the llama trails than in the line of stones and corrals, it is, again, a much more reasonable thing that the trails were made at a time when the lake waters stood near the level of the old beach, and no better course could be found by the traveller than the relatively flat-topped beach, rough and stony as it is.

Conclusion.—It is too often the case that students who are unwilling

to accept the conclusion of climatic change in the human period base their chief argument, or, as we might say, their arraignment, upon the illogical quality of much of the evidence. But is it not true that it is a case, to use rather an absurd illustration, of the chain being as strong as its strongest rather than its weakest link? It is not the weakness of the weak evidence, but the strength of the strongest, that should be regarded as determinative. In both Darwin's notes and those of Moreno are many facts which very obviously do not bear critical analysis, or at least in themselves do not warrant a conclusion of any sort, however harmonious they may be with respect to a conclusion

FIG. 4.—THE ABANDONED TRAIL AND CORRALS ON THE SOUTHERN EDGE OF THE HUASCO BASIN.

The view looks east by north-east from the gorge next east of Huasco Lipez (Fig. 1). To the left of the centre is the southernmost of the twin peaks of Huasco. The gorge of Rinconado is between this peak and the hill on the right margin of the photograph. Fragments of the walls of the old corral may be seen in the immediate foreground, and the line of stones running marginal to the old trail, and from corral to corral, may be clearly identified. The isolated heaps of stones seen to the right of the corral and trail are ancient and now nearly demolished *signos del camino*, or "signs of the way." The photograph is taken from the western edge of the gorge and directly opposite the abandoned corral.

based on stronger evidence. Yet, in both cases, there are indisputable facts of observation clearly stated, and incapable of misinterpretation in the text, and, it would seem, of misrepresentation in the field. In the one case the ruins are in a valley, in the other chiefly in interior basins. In both no foreign source of water-supply can be invoked for the conditions of topography and drainage supply, reasons that from the evidence at hand appear irrefutable.

Concerning our own observations, I shall merely say, in conclusion, that the photographs and map so clearly represent the conditions of Lake Huasco that there is but little necessity for much further argument.

The evidence relates to roads, not to conditions of human habitability, and the conclusion rests upon a belief that the roads then, as now, were selected with a measure of reason. The hard conditions of travel in an inhospitable mountain country make unnecessary circuitousness within short distances a practical absurdity. The llama trails upon the stony beaches, no longer followed because of the incomparably better road below, and the roundabout route on the south side of the basin, long since abandoned for a better one, appear to offer proofs of a convincing order.

Putting the evidences from the three sources in review, one notes, as concluding features, their wide geographical distribution, their interpretative dependence upon absolutely different criteria, the apparently incontrovertible nature of *some* of the evidence in *each* group, and finally the fact that it is just that evidence that in the first two cases is gathered first hand by the recorder himself that is most convincing. So that, with the hearsay evidence entirely omitted, the conclusions we have drawn upon direct evidence of profound climatic change within the human period seem not only tenable but obligatory.*

EXPLORATION IN THE TIAN-SHAN MOUNTAINS.

By Dr. GOTTFRIED MERZBACHER.

My expedition is ended, and, now on my way home, I hasten to forward provisionally a few particulars respecting its course. Only in their broad features and in a cursory manner can I sketch the routes pursued by the expedition. Of the abundance of observations collected, a few passing indications are all that can here be offered. So soon as circumstances permit, it will be my endeavour to fill in the lacunæ by a somewhat more detailed "Provisional Report."

As shown in my communication dated February 15, 1908 (see *Journal*, vol. **31**, pp. 395–400), the first year of the expedition was devoted to a more exact exploration of the systems of the chief rivers of the eastern central Tian-Shan, the Agias and Kok-su to an *in*tensive study, so to say. Following up its programme, the expedition's second year was, on the other hand, occupied more with *ex*tensive labours. The disadvantages necessarily involved in this procedure were, however, richly counterbalanced by the fact that a general view was thereby obtained over an immense region and over the homogeneous geological and morphological phenomena constantly recurring therein. Through the comparison thus rendered possible, the genetic connection of the phenomena and their further relation to other facts previously observed elsewhere, such as had hitherto seemed enigmatical or doubtful, was cleared up, and one could gradually arrive at an estimate of the forces

* The climatic change itself, and the physical evidence for it in the form of low-altitude moraines, U-shaped valleys, cirques, glaciated rock surfaces, and abandoned shore-lines in other Andine basins will be described in a later paper.

that in the main determined the present configuration of the Tian-Shan, and in particular of the way in which those forces acted.

To gain the most correct idea possible of the geological structure of the eastern Tian-Shan, the plan was adopted of several times crossing the whole of the chains constituting it, and, as far as possible, in a direction transverse to their strike. This plan was in part successfully carried out, and several nearly complete geological cross-sections could thus be obtained.

As mentioned at the close of my communication above referred to, the final break up from winter quarters at Kulja was fixed for the beginning of March, dependent though it was on the timely arrival of my new geological coadjutor, Dr. P. Groeber. Owing, however, to unforeseen circumstances, his arrival was so long delayed that I was unable to start from Kulja till April 27. To make up for the loss of the guide, Franz Kostner, who had returned home, the expedition secured the services of Franz Wenter from Tiers, near Bozen, in the same capacity. Otherwise its *personnel* was similar to that of the previous year. Besides the three Europeans, it consisted of two Cossacks and another Russian of Central Asia, four Sarts, and two Kirghizes, with a complement of twenty-six to thirty horses.

The first objective was the great longitudinal valley of the Kungess (about 160 miles long), drained by the headwaters of the Ili. The Ili first takes this name after having, as the Kungess, united its waters with those of the Kash, which runs parallel to it, and is hardly inferior to it in size, and debouched into the wide Kulja basin. This valley, leading into the heart of the eastern Tian-Shan, and keeping in its lower course the character of a wide high steppe framed by but moderately high mountain chains, was followed up to near its head. Having reached the upper course of the Kungess, where the landscape has already assumed the character of a high mountainous region, the expedition turned southwards, crossing by the higher passes of Tai-assu and Dagüt, the watershed towards the Yuldus and the intervening longitudinal valley of Zanma. By this course the expedition reached the largest valley system in the eastern Tian-Shan, that of the Chaidik-gol, which flows through the Yuldus valleys, already highly remarkable for their conformation. The study of these valleys and of the causes of their peculiar course formed one of the chief problems of the expedition. In the Yuldus valleys even the Tian-Shan traveller, long habituated to imposing scenery, is astonished at the dimensions of the mountain chains comprehended in one outlook, though extending apparently into the immensity of space, at the grand monotony of the ranges which constitute the landscape, and lastly by the hundreds of *névé* basins which strike his eye, whose waters go to swell the mighty Chaidik-gol.

Pursuing its way eastwards up the so-called "Little Yuldus" valley, some 95 miles wide, up to the region of its headwaters, the expedition

came to the Kotil pass. In the geological structure of its bounding walls, as also in its grand morphological aspects, the valley of this river presents a series of important problems, the full solution of which, however, owing to its inhospitable character, presents insurmountable difficulties. It was impossible to overtake all the work that was then calling to be done, though the material there collected is of the greatest interest. Among other things it may be worth noting that my former assumption respecting the enormous development of the glaciation in the past of the southern slope of the Tian-Shan range was fully confirmed. On May 20 we reached the town of Karashar, which enjoys the great advantage of being situated on the imposing river Chaidik-gol, here fully one-third of a mile broad. Thence we proceeded to the north bank of the great lake, Bagrach-Kul. The expedition next followed its outlet, the Konge-daria, which, in a narrow defile (incorrectly represented in existing maps), breaks through the southern border ranges of the Tian-Shan. And so we arrived at the town of Kurla. Following the foot of the southern declivity of the Tian-Shan for a distance of over 200 miles, we next travelled by way of Bugur to Kucha, one of the most considerable, and in many respects the most charming, of all the towns in the Tarim basin. In consequence of the belated start from Kulja, we arrived at the now overheated southern sides at least four weeks too late, and the members of the expedition suffered much on the march from the enormous heat and the sand-storms.

At Kucha, where I was about 60 miles, on a bee-line, from the extreme eastern point of my route in the last expedition (1903), it devolved on me to make comprehensive preparations for the most difficult and doubtful part of the whole enterprise. Here, where the eastern Tian-Shan attains its greatest breadth, little short of the extreme breadth of the central part of the range, to the average vertical elevation of which it closely approximates, we had to face the task of crossing transversely, in as direct a line as possible, the entire complex, in order to obtain a complete geological profile. For such an undertaking the available bases were inadequate, the intelligence scanty and contradictory, the season unfavourable—four weeks too early or too late. Still I determined to carry my design into execution.

On June 6 the task was begun, its first part being executed with comparative ease. But the farther we pressed northwards the more did difficulties accumulate, threatening at last to become insurmountable, so that we seemed almost driven to the fatal necessity of retracing our steps. And matters might, indeed, have come to such a pass had not the season grown too late, but the circumstances did not allow a retreat. Rivers were so much swollen, that we crossed only under the most difficult circumstances, and we could not comply with the risk to recross them on the eventuality of a retreat. Besides, the northern slopes of the passes already crossed were too steep to be climbed in an

eventual retreat. There was no choice left us but at any cost to push our way northwards. Happily, the results obtained were proportionate to the difficulties and dangers overcome.

In this journey, through country hitherto unexplored, almost each day's march brought with it fresh and unexpected discoveries, and exceedingly valuable observations were secured. We pushed our way into the mountains through the great transverse valley of Kiu-Kenik, which bears also the names of Kiju-Kule, Kuji-Kule, Kuju-Kunnuk, Kiu-Kelik, and is besides quite wrongly represented in our maps. In its peculiar course the valley shows a remarkable variety of features. While trending north it cuts through various younger formations of very diverse age, which, by their geological structure, the peculiar effects wrought on them by climate, and their vivid colouring, form landscapes of a rare type and of a charm all their own. The middle section of the valley being impassable, a diversion had to be made westwards into the neighbouring valleys of Kizil-Ketun and Dshon-Jailak, and several passes crossed. Thence, again bending eastwards, we reached the upper course of the main valley, which is carved out of palæozoic formations and the series of eruptive rocks connected with them.

The further march to the north-east brought the expedition through a morphologically interesting region of lakes (either already desiccated or in process of desiccation) to the foot of the high Kok-tepe chain, which, in consequence of the slight extent to which its ridge has been indented, offers but few crossing-places. We crossed the chain at Kiu-Kenik pass, which, structurally, plays an important *rôle* in this part of the mountain system. A second pass surmounted, we descended northwards, and came into the valley of the northern Kiu-Kenik, known also as Zagan-ussun.* This, one of the most important affluents of the Chaidik-gol, breaks through the chains which hem in the "Great Yuldus" valley on the south. And the place at which it cleaves its way through them is exactly the spot where they present the greatest elevation, the boldest and most manifold mountain forms, and the most important development of glaciers—a development far exceeding my expectations. Even in the Tian-Shan there are not many mountain scenes to surpass in grandeur the panorama here disclosed. The marked thermal contrast between the heights of so considerable elevation and the wide-extended steppes of the floor of the valley, exposed as they are to an intense solar radiation, causes the mountain chains to be in the summer season mostly veiled in clouds, and heavy rains are, as a rule, a daily occurrence.

Having entered the "Great Yuldus" valley we turned westwards, where we were confronted with the task of more closely investigating the eastern continuation of the great conglomerate mountains of the upper Kok-su, mentioned in my former letter, so as to arrive at a more

* In this part of the Tian-Shan also the valleys radiating in different directions from a particular point of a mountain crest often bear the same name.

complete understanding of the mode of their formation. Not only were these investigations crowned with success, but it was further possible to make a series of important observations relative to the tectonics of a large part of the Tian-Shan, the development and present conformation of the valleys of the Kok-su and Yuldus, and finally, to a knowledge of the phases of their former glaciation. In the course of these investigations I crossed the southern one of the Karagaitash passes, and once more entered the Karagaitash valleys, visited the year before, and thence reached, for the second time, the uppermost region of the Kok-su. Dr. Groeber, meanwhile, made his way beyond the headwaters of the Kok-su, over the pass of Ulan-bulak. Our roads offered welcome opportunities of supplementing my previous year's observations.

On its way back to the "Little Yuldus" valley the expedition visited the summer residence of the most important chief of the Torguts, who in the summer months, with the greatest part of his nomadic folk, frequents the wide steppe-regions of the valleys of the Yuldus and its tributaries. The splendid "yurts" (felt tents) of the chief's family, and the many others which served as temples to the numerous lamas here assembled, offered much that was interesting. I was most hospitably entertained, and the Torgut officials were lavish of their assistance on behalf of my further undertakings.

In the "Little Yuldus" valley Dr. Groeber was successfully engaged in investigating the transgressive upper strata of the lower carboniferous there considerably developed. I on my part made ready for a further advance northwards, an advance which brought us to the transverse valley of Dunde-Kelde. There, too, we lighted on palæontological finds, the closer examination of which should be of great import for the determination of the age of the so-called "younger formations" of the Tian-Shan and of their mode of origin. We succeeded in making valuable observations on the tectonics of the region, especially at the termination of the valley at the crossing of the Dunde-Kelde pass, which gives passage northward. Arrived at the northern foot of the pass, the expedition found itself in the valley of the Khustai, the uppermost headstream of the great glacier-fed river Manass, the most considerable of all the rivers draining the northern slope of the eastern Tian-Shan. On crossing the pass the great and widely glaciated chain of Iran-Charbut lay before my eyes for the first time. It forms the backbone of the eastern Tian-Shan. Here, too, as everywhere in the eastern part of the range, the extremely slight indentation of the summit ridge is an important characteristic. There are no easy passes accessible to a large caravan. This unfavourable state of things is aggravated by the circumstance that none of the great river-valleys offers a practicable route throughout its whole course, and that the streams which traverse them, fed as they are by the great accumulations of *névé* stored up in the numerous head and lateral valleys, are heavily swollen

and extremely rapid, and consequently fordable at few spots, and at these only with great difficulty, which is heightened by their very winding courses hemmed in between steep rock-walls. Rich as is the growth of alpine grass in these valleys, they still, therefore, continue uninhabited, even the nomadic Kirghiz and Mongols avoiding them. Only in the winter, when the water-level is low, do the nomads frequent them. In these desolate regions the traveller cannot reckon on finding help or supplies. These circumstances will explain the difficulties I encountered in the execution of my task. The only course open was to endeavour—so soon as its canyon-like contractions rendered one valley impassable—to reach the next parallel valley by crossing a pass in the intervening chain. There we could once more prosecute our northward march till again compelled to have recourse to the like toilsome mode of egress.

In this way I followed first the course of the great mountain river, the Manass, into which numerous large glacier streams, emerging from an extremely ramified valley system, pour their muddy water with bewildering uproar. Repeatedly crossing the main river, the expedition was several times in no slight danger, which at first made me doubtful about trying the venture too often. When, however, in shunning this risk we also failed to force a passage across the Askti pass, it seemed as though the expedition were cut off alike from advance and from retreat. Only after great dangers did we at last succeed in gaining the foot of another pass, the Tsintetoe. After successfully effecting this high and difficult passage, we were able to descend into the valley of Charagaitoe. But as this offered no other outlet, there was no help for us but to cross a farther high gap in the mountains, the Tsoe pass. We next descended into one of the most magnificent alpine valleys of the eastern Tian-Shan, that of Chorgoss. As a background to its principal head and lateral valleys, the grandest mountain forms tower up before the traveller, who sees extended before him the most important glaciers of the eastern Tian-Shan. The glaciers I found in a stage of marked retreat.

Less impracticable was the road over the Tainu pass, which commanded a comprehensive view of the glacier regions of the whole of this region. This passage admitted us to the great alpine valley of Ulang-su. Greatly swollen by the waters derived from numerous *névé* fields in its lateral valleys, and terribly wild, the Ulang-su river opposed great obstacles to the further march of the expedition.

Defiles and rapids at length completely barred further passage in the valley of the river; yet, as the provisions were at an end, some outlet had to be found at whatever cost. The beginning of the venture was hazardous. We had to negotiate a series of eight passes in order to cross the deeply furrowed mountain complex to the west of the Ulang-su and reach the passable Koi-ashu valley, which led us out to the gently sloping northern declivity of the range.

A march of several days was now made through the more recent chain of hills which fringed the northern foot of the old mountain system. These hills are of much interest, especially from a morphological point of view. The expedition thus reached Shikhodse on the northern imperial highway, and thence arrived, on July 22, at the town of Manass. Our arrival here at a date so much later than anticipated filled me with forebodings as to how the further extensive programme was to be executed. I therefore abandoned my previous intention of travelling eastwards along the foot of the range, and availed myself of the imperial highway to journey to the large town of Urumchi, the seat of the central government of the province. There we made a longish halt in order to reorganize the expedition for the exploration of the easternmost of the great glaciated chains, the Bogdo-Ola, and replenish our supplies. On July 31 we resumed our march, which took us at first eastward to the town of Fu-kan. My intention was to combine as careful an exploration as possible of the central and highest part of the chain and its extensive glaciation, which had already impressed us from a distance with a complete traverse from north to south, in order to obtain a geological cross-section. If hitherto the weather had on the whole been pretty favourable to our travels, it now entirely changed. Owing to the considerable vertical elevation of this mountain mass (much over 17,000 feet), between the northern Gobi and the deep depression of the wide Turfan basin on the south, the Bogdo-Ola district is a scene of perpetual storms. Nevertheless it was found possible to carry out the programme. The great transverse valley of Bogdo-Ola leads from Fu-kan to the central portion of the range. It offered the means of advancing directly southwards, transversely to the trend of the chains. In its lower course, the valley is wholly carved out of the coal-bearing formations, supposed to be of comparatively recent age, which are here developed to an extraordinary degree, and of which a thorough examination was to be the task of Dr. Groeber. He succeeded in making some important discoveries of fossils, the determination of which seems likely to shift the age of these deposits back to a considerably more remote era than has been hitherto assumed. Even in these secondary chains, close as they approach to the border of the Gobi, the traces of the diluvial ice-age surprise us by the extent of their development, while they are exposed to view in an unmistakable manner. The Bogdo-Ola valley is watered by the principal effluent of the magnificent alpine lake, Bogdo-Ola, to which it guided us. This lake and its environment may, in point of scenery, be taken as the pearl of the eastern Tian-Shan. It is hard to conceive of anything more charming.

This may be the reason why in their simple faith the Chinese of the plain look on the lake as sacred, and make it the theatre of their religious myths. A number of monasteries are seen towering up, romantically planted on the beautifully wooded mountains which encircle

the lake, and are mirrored in its blue waters, grandly overtopped by the icy peaks of the central Bogdo-Ola group.

Owing to the deep ravines which intersect this region, our further advance to the northern foot of these magnificent mountains encountered many obstacles. From a high camp at the northern foot of the icy chain, and again, after crossing the Miskan Pass which cuts through the heart of the group, from a camp at its southern foot, I occupied myself with the study of the geological structure of the chain and of its widely extended glaciers. The ascent of some high glaciated mountains on the north and on the south border materially furthered these labours.

Meanwhile Dr. Groeber successfully prosecuted his investigations, further eastwards, into the structure and composition of the "younger" part of the range, plotting the results in section. On the way down southwards to Lake Sayopu the expedition reunited, and on August 25 again returned to the northern slope on its way to Urumchi. The season being so advanced, it behoved us to press forward with all possible speed to the more western field of work, which had been included in our plan of travel. I therefore again made use of the Imperial highway—mockery of a highway as it is—in order to return to Manass, and thence to make a further journey to Shikho. From this town it was my intention to go southwards once more, and to cross the mountain chain, by a route as nearly transverse as possible, into the uppermost part of the great longitudinal valley of the Kash, and thence to the headwaters of the Kungess. This would have brought us into the way leading southwards from the valley of the Kungess, which we had struck in the spring. By this course it would have been possible to complete a further geological cross-section, but our design was opposed by the above-mentioned peculiarity in the structure of the chains constituting the Iran-Charbut mountain system, namely, the small indentation coupled with the great elevation of the crests. Only a few of the great rivers flowing northwards take their rise in the main crest of the range, but most of them in the secondary chains in front, and there are therefore no great valleys leading to the main watershed, which accordingly shows no important indentations. In a length of about 125 miles, from the meridian of the Manass rivers westwards to nearly the western end, there is not so much as a single pass admitting passage from north to south of this range.

From Shikho I made my way with the caravan to Sigoshur, the seat of another Torgut chief, who showed me much hospitality, and thence southwards to the great and picturesquely constructed Buddhist monastery of Zagan-ussun, situated immediately at the foot of the high mountains. From this place I made the ascent of a high pinnacle, whence I commanded an instructive view of the structure of the mountains and their glaciation. Unfortunately, I had also to admit the fact that the planned advance southwards through the great transverse valley of Jirgaltoe was

not practicable. A continuous covering of *névé* crest and walls, coupled with an absence of great valley glaciers, again characterizes the glaciation of the north side of the mountains, still so wholly unknown. While searching for a passage further west, the expedition pursued its way to the town of Jinkho with the intention of travelling thence to the valley of Dundoe-Iin, south-south-east of this town. This valley, with the second mountain valley of Dundo-Mutun, was said to give access to a pass—Shari-davan—forming a gap in the main crest, and often used, it was alleged, by the Kalmucks. In this way we hoped at last to reach the Kash valley. Turning in an upward direction, in country interesting for the clearly exposed granite intrusions, we came to the residence of another Torgut prince. Thanks to his friendly assistance, we now reached the range forming the water parting on the side of the Kash valley, not, however, by way of the Shari-davan, which caused me at first some vexation, but further west. This time, however, chance had done us a good turn. The way we took over the Ara-Mutun, Dondo-Khustai, Nilkha, Shargutoe, and Kursai passes, through the valleys of Khar-Mutun, Salikh-toe, Khojurno-Ussun, and Nilkha, and finally, down through that of Borogobossun to the Kash, led through a region which, from a tectonic and morphological point of view, is one of the most interesting in the Tian-Shan, so far as known to me. Instructive phenomena succeed one another in rapid sequence. The phases of past glaciation can likewise be studied as from an open book. Of lower carbonic fossils we were able to gather a rich harvest in excellent preservation. The detailed exploration of the great longitudinal valley of the Kash—140 miles long in a bee-line, and over 200 in actual length—had been planned as the concluding task of the present season. For the history of the formation of the Tian-Shan the valley offers problems of the greatest importance. This is apparent in the heterogeneous form and in the varied character of the landscape of the different sections of the valley. The two great longitudinal valleys, Kungess and Kash, running approximately parallel to each other, once formed a common basin, the formation of which is most closely connected with the deep-seated disturbances to which the Tian-Shan owes its present configuration. The line of elevation which separates the middle and lower courses of both valleys can hardly be dignified by the name of mountains, even when viewed from the Kungess valley, the floor of which lies considerably lower than that of the Kash. For the geological location of the series of quartz-porphyry rocks, so widely distributed and so extensively exposed in the Tian-Shan, indications of great value may be here observed. Among the subjects of investigation were included the relation of the granite, here attaining an unusual development, to the limestones; a study of the younger sediments so well developed in the Kash basin, with their rich coal deposits, and here and there also with their well-preserved

fossils; as well as the present and past glacierization of the heights bounding the valley.

In order to throw light on these questions, it was necessary to ascend the Kash valley to its highest sources. In connection with our present object, we proposed to cross the watershed between the Kash and Kungess several times and at different places, as also to advance into the region of the headwaters of the Kungess and the watershed between it and the Yuldus. Unfortunately, the design could only be carried out in part.*

We pushed our way up the river, first on its right and then on its left bank, turning the impassable parts by making use of a series of transverse valleys and the passes connecting them. We then passed over to the right bank, whence we pressed northwards through the Mungati valley to the high watershed. On our further march up the valley, we kept steadily to the right bank, and after long wandering reached the hot springs near the end of the valley.* From a camp which we made there, we visited both the Borochoro valley, one of the largest upper valleys of the Kash, and the uppermost basin of the Kash itself. By ascending several important heights, a commanding view was gained of their glaciated portions. The present development of glaciers in Kash valleys and its lateral valleys fell behind my expectations. There was indeed an extensive display of *névé* both on the crest and walls, and a very large number of *névé*-basins and of glaciers was seen in the upper valleys. Of valley glaciers proper, however, there are but few, and these of no very great extent. Their tongues are almost without exception in a stage of marked retreat. The evidences of diluvial glaciation in this enormous valley system are likewise not nearly so numerous as in the other great valley-basins of the Tian-Shan. Special circumstances, which cannot be entered into here, may possibly have effaced the traces of such action. A tributary river on the left bank, comparable to the headstream itself, particularly attracted my attention in consequence of its great volume of water as compared with the shortness of its course. I conjectured that there must be a considerable extent of glaciation in the area behind its valley, which bears the name Borgora. To clear up the matter, I made an advance into the valley, which I found barred by an impassable zone of vegetation, but from a peak which I climbed for the purpose, I was able to verify the presence of masses of *névé* and glacier falling far short of those of the principal valley.

Hitherto the weather, especially in the fall of the year, had been very favourable to the labours of the expedition. On October 21, however, a sudden and drastic change set in, the winter overtaking us

* Such hot springs are also met with in many places in the transverse valleys, especially in those discharging from the northern chain, and are closely connected with tectonic disturbances.

all at once with great violence. Severe cold and long-continuing snowstorms threatened to cut off our retreat. We had to hasten with all speed to lower altitudes. On approaching the lower middle course of the main valley we were all at once vouchsafed a taste of the terrible fury of the Tian-Shan winter. After a visit to the great Buddhist monastery of Bogdan-Kura, the largest in the whole of the Tian-Shan region, we were surprised by a snowstorm of eighteen hours' duration, which in violence was no whit behind the severest blizzard.

A thick and uniform snowy mantle now overspread the mountains down to the bottom of the valley, imperatively ordering all wanderers, however eager for action, to cease from their labours. Great was my regret at this. Only three weeks more of favourable weather, and the important investigations in the Kash-Kungess basin would be happily completed. At the outlet of the Kash valley, towards the Kulja basin, where the tectonic conditions are unusually complex, we made our final geological observations, which agreed in a satisfactory way with the examination of the same ground at the beginning of the season. With the return to Kulja on November 5 the period of exploration was at an end. Thence Dr. Groeber passed, by way of the Musart pass, into the Kashghar basin, to work there for some months longer, while I was occupied for some time with the arrangement and despatch of the collections.

If, then, it had once more proved impossible to accomplish everything which I had set before me, I may yet, I trust, look back with some satisfaction on these two years of labour and toil. In this last year especially wide regions were traversed, which were in part still very imperfectly known, in part wholly unknown, and a comprehensive knowledge was obtained of the structure of the eastern Tian-Shan.

So soon as the material necessary for the purpose has been housed and sifted, I shall apply myself to the task of drawing up a "Provisional Report" giving a general summary of results. This will, if possible, be provided with a general map, in which some account will be taken of the rich material at my disposal in the form of careful route-surveys, determinations of position as well as of altitude, the last both trigonometrical and barometrical.

The year's harvest is satisfactory also as regards the collections obtained. There is an abundance of material awaiting treatment, especially under the heads of geology and palæontology. The zoological and botanical collections offer much that is interesting, and form a welcome supplement to the material brought home the years before. The result of the photographic labours will be exceedingly rich, and I am in hopes of being able to illustrate my researches by a great number of successful panoramas and tele-panoramas. The results of the meteorological observations, which were regularly carried out, will also supply an important basis for a climatology of the Tian-Shan.

SWEDISH MAGELLANIC EXPEDITION, 1907–1909.

By C. SKOTTSBERG, D.Sc., Leader of the Expedition.

V. Excursions during the Winter Months (July to September), 1908.

When the expedition returned from the survey of the Patagonian channels, on June 27, the winter had already set in, and it thus proved necessary to widen our field of work a little towards the north. We resolved to continue our investigations as far as to the archipelago of Chiloe, and besides arranged with the Chilean Government to get a vessel for a trip to the famous Juan Fernandez islands. On July 9 we arrived in Ancud, the small capital of the island Chiloe. The first days were spent in surveying round the place in all directions. Then the leader of the hydrographical station in Puerto Montt, Commander R. Maldonado, of the Chilean navy, put a small vessel at our disposal, and made it possible for us to survey the whole east and south of the archipelago, to pay a visit to the remote island Huafo, and also to the opposite coast of the continent from Corcovado to Reñihue. From thence we returned to Chiloe, where my companions travelled overland from Castro to Ancud. On August 10 we left for the north. Mr. Halle stopped in Coronel, having a large field for observations in the coal-mines of the province Arauco, where he could with great advantage continue his studies from the south of Patagonia. Mr. Quensel and I myself went to Valparaiso, where we soon obtained the use of a large transport vessel, the *Casma*, which took us to the Juan Fernandez group. We sailed on August 20, and returned on the 31st, having visited both Masatierra and Masafuera. After some excursions from Santiago, studies in the National Museum, and preparations for the next campaign, we all met and returned south to Puerto Montt. From there we have followed the common track to the great and well-known Lake Nahuelhuapi. In a few days more we hope to leave with horses and equipment, and return overland to South Patagonia.

I am now able to give the following short communications of the results obtained during these last months.

1. *The Excursions in Chiloe: Phytogeographical and Biological Notes.*

As I have already mentioned in a previous report, I had a splendid opportunity, during the voyage through the Patagonian channels, of following step by step the changing of the sub-Antarctic rain-forest into the type known as the South Chilean. It was thus of great value to be able now to compare the first one with the richly developed forests of Chiloe and the coast. Very large stretches are still untouched by man; only round the shores of Chiloe and in some river-mouths on the coast population is found. An investigation of the forest offers great difficulties. I made an excursion to the interior of the San Pedro island, on the very spot where Darwin once attacked it, and I got exactly the same impression,

every step being a hard struggle. The main difference between this kind of forest and the sub-Antarctic lies in the richness of different trees, of creepers and winding plants, as well as of true epiphytes, in the former.

For my algological studies, which, through my taking part in the Swedish Antarctic voyage in 1901–03, include a large part of the south, where the hydrographical conditions are very uniform, it was of importance to get some observation spots in a lower latitude, where I could prove that the same associations, containing almost the same species, are still existing. Dredgings were made to a depth of 10 fathoms, and rich zoological harvests also obtained.

Mr. T. Halle writes of his geological observations as follows :—

"The main features of the geology of Chiloe are known through the observations of Charles Darwin. Along the northern part of the west coast the rock consists of metamorphosed crystallinic slates. On the top of these comes a series of sandstones, clay, and conglomerate of Tertiary age. Then along the east coast follows a series of more loose and certainly younger conglomerates, often with boulders of 3 feet in diameter, or clay and loose sandstones; besides, in a subordinate way, occur young volcanic deposits.

"The principal object of my work was a close investigation of the Tertiary layers. A proper knowledge of these layers, together with the observations made in the Magellan territory, will be of importance for the final solution of the hitherto unsolved question of the parallelization of the different Tertiary deposits in South Chile. Marine fossils are very rare, and a more extensive collection was made only on the small island Huafo. Plant-fossils were met with in several places, which will give varied information on the vegetation and climate in this latitude during the Tertiary epoch.

"The above-mentioned series of probably post-Tertiary origin on the east coast is of great interest. It seems difficult to explain the presence of the large boulders in the conglomerate. In one place I found, in a clay belonging to this formation, several plant fossils, which seem to be sufficient for a determination of the age. They are very like recent species."

Mr. P. D. Quensel reports as follows on his studies of the geology and geography of the coastal cordillera from the Straits of Magellan to Chiloe.

"I shall here give a summary of my observations of the coast region between the main range of the Cordillera and the Pacific ocean.

"From the straits to the Peñas gulf, we everywhere find the same eruptive rock, always similar in its outer occurrence, but varying considerably in its chemical composition. It appears in granitic, syenitic, or dyoritic variations, all linked together with numerous transitions. The western limit of this eruptive zone does not stretch very far to the west of the island region. The Evangelistas islands consist of metamorphosed sedimentary deposits. Towards the east the eruptive zone

is limited by the clay-slates of the central Cordillera, and it is a remarkable fact that there is a distinct coincidence between the zone of the channels and the eruptive rock; where the channels end towards the east, the contact between the eruptives and the clay-slates is found. And so quite naturally rises the question of the origin of the channels and the age of the rock. The comparatively young age of these beds has been pointed out before, and regarding them as equal to the kind of work forming the coast Cordillera further north, they should belong to the Lower Tertiary formation. But treating of a rock of such a small age, one is astonished at not finding the slightest trace of the beds that must have covered it, as it shows all the character of a rock originated at a great depth. A very considerable erosion must have been acting here without having had time yet to cut down the eruptive mass, which is seen by the regular hummock-shaped mountains, with well-defined cleavage following the topographical outlines. It is most probable that many of the Patagonian channels are of tectonic origin, especially the main channels running north and south, being an unbroken continuation of the large Chilean central valley. But it is quite as possible that many of the small side channels, crossing each other in various directions, must be regarded as effects of erosion submerged as valleys. Very often one can follow their passing into a mountain valley, and on more than one occasion I noticed, from the soundings, two such valleys joining far out in the channel.

"I just mentioned that, going towards the east, the eruptive zone is replaced by more or less metamorphosed clay-slates, probably of the same age as the 'Vorgebiege' of the east Cordillera, *i.e.* belonging to the Upper Cretaceous. Then follows the zone of andesitic rocks, from which samples are carried in profusion by the glaciers coming down to the sea-level in the interior of the side channels. A very good example is Peel inlet, where one cannot fail noticing at once the sharp rugged outlines of the young volcanic mountains. As far south as the peninsula Muñoz Gamero the andesitic mountains are found, always forming the highest peaks. Mount Burney was found to consist of this kind of rock, and numerous deposits of pumicestone round its foot prove that eruptions took place as late as in the post-Glacial period.

"Mr. Halle has already mentioned the main stratigraphical features of the island of Chiloe. On the continent, on the other side of the Corcovedo gulf, we again met with the granitic eruptive zone, and far to the east we observe the stately range of volcanoes breaking up through the disturbed sedimentary layers.

"There is not very much to be said of the glacial geology of the west Cordillera. Everywhere in the south the great ice-age has left traces behind. The northern limit, where the ice reached the sea-level, seems to have been Estero Reñihue (72° 30′ S. lat.). Along the whole east coast of Chiloe and on the islands in the gulf numerous large blocks

are found round the shores. They consist of the granitic rock that forms the coast of the continent, but does not exist on Chiloe. No traces of glaciation are found on Chiloe, and I can explain the presence of these blocks only by an ice-transport from the opposite side. But the question is not so simple as it at first looks. The same blocks are found in conglomerate beds about 30 feet above sea-level, their occurrence on the shore thus being of secondary nature. However, I can see no other possibility than regarding them as originally transported there by drifting ice, the whole conglomerate then being of glacial age."

2. *The Excursion to the Juan-Fernandez-group: Biological Remarks.*

From a phytogeographical point of view Robinson island is very famous indeed, not less than 62 per cent. of the phanerogamous plants being endemic. Amongst all the islands there is only one single group, the Sandwich, that shows a greater percentage; and of these plants many are very remarkable from a systematic point of view. Of course the flora is very well known, but still there was much to be done in a physiognomical way, and it was of very high interest for me to see this isolated vegetation and compare it with the Chilean coast. Perhaps the marine flora, hitherto rather neglected, offered still more interest. Through my studies I ought to have a fair idea of the general appearance of the associations luxuriating in sub-Antarctic waters. A branch from the cold south, generally called the Humboldt Current, follows the west coast of South America, and gives birth to a very monotonous flora. But the Juan Fernandez islands lie just out of reach of this cold water, and thus the aspect of the marine plant-life is at once completely changed. The characteristic formations of the gigantic sub-Antarctic algæ, growing in abundance still at the latitude of Valparaiso, such as Durvillea, Lessonia, and Macrocystis, have disappeared.

Besides these studies, I had the good luck to make a small discovery on Masafuera, which in a most unexpected way connected my observations here with the work carried out in the sub-Antarctic lands. At a height of 3000 to 3500 feet above sea-level, I found a poor alpine flora hitherto unknown and formed of well-known species common in Patagonia, Tierra del Fuego, and even in the Falklands, where I have studied them under different circumstances. I hope this find will be of some value for the theories on the origin and migrations of the floras after the Tertiary epoch.

Finally, I here take the opportunity to fix the attention, not only of the scientist, but also of everybody who loves nature. For a long time the precious flora and fauna of the islands have been threatened with destruction. The colonists who have occupied sections of ground are constantly spreading widely, and forest has been cut down or even burnt. But if we even may admit these conditions as inevitable — though I cannot see why this little spot should be used for cultivation,

being of absolutely no importance for this object—there is no reason why many interesting species should be threatened with extinction only for the sake of pleasure. Every ship brings quite a load of the precious endemic ferns and young plants of the endemic palm tree (*Juania australis*) to plant them on the coast, where they do not thrive. And the old handsome palm trees are cut down for the lofty purpose of making walking-sticks of the beautiful wood. People ought to take warning by the ill-fated sandal-tree (*Santalum fernandezianum*). Even fifteen years ago this species, from a geographical point of view of the highest interest, was believed to be completely extinct. Then one single tree was discovered. We were brought to the spot by the son of the discoverer, and thus got to see and photograph probably the last individual of a noble race of plants. It is an old, dying tree with only one single branch still green. Masafuera island is not very often visited, being almost inaccessible except in very good weather. But here the Chilean Government is thinking of establishing a penal colony. And the commission which investigated the place recommends as occupation for the convicts, besides agriculture, also forest-cutting. I suppose they did not remember that the tree which constitutes the insignificant forest patches in some of the valleys is the *Myrceugenia Schultzii*, a species not found elsewhere in the world, not even on Masatierra.

I have had the honour of pointing out these facts to the Chilean authorities, and to tell them that something must be done to protect these islands. What a beautiful place for a biological station, in the middle of the ocean, with an immense field of work! The place is well worth being reserved for science alone—without inconvenience. The fishing establishment could go on with its work, or even drive it on a much larger scale. With these words I have wanted to call the attention of the scientific geographical circles to the place and to its future.

Mr. P. D. Quensel writes the following note on the geological formation of the island:—

"About 360 miles to the west of Valparaiso is situated the small volcanic island Masatierra, and 90 miles farther out Masafuera. If one casts a glance on the map of South America, one will see that several other volcanic islands are situated in the Pacific, at the same distance from the coast, such as, San Felix and S. Ambrosio and the Galapagos group. A line uniting them very regularly follows the coast, and at the same time the direction of the Cordillera. During the last years, Chilean naval officers have found banks between Juan Fernandez and San Felix. These islands thus seem to form the peaks of a submarine volcanic range.

"On the geological structure there is not much to be said. Masatierra still shows the outlines of a double crater, the perpendicular cliffs round the large semicircular depressions seem to indicate where the crater walls have stood. Large deposits of volcanic sand and ashes, as well as a breccia, fill the bottom of these valleys. The rock is a basalt, and

contains much olivine. Masafuera has a rather different aspect from Masatierra. It rises steep out of the sea to a height of about 6000 feet. Towards north and east radiate very deeply cut valleys, veritable cañons. The rock is more coarsely crystallinic than on Masatierra."

3. *Mr. T. Halle's Remarks on the Geology of the Coal-mines between Coronel and Lebu.*

"I spent five weeks working in the coal district in the province Arauco. According to a determination published by Prof. Nathorst, Dr. Dusén collected a glossopteris in Lebu, this genus being the typical fossil of the Gondwana series. As I had studied this formation on the Falklands, I was anxious to visit the locality. I found the same fossil fern, and made some observations of interest, which I, however, cannot deal with yet, from reasons not to be mentioned here.

"The coal-mines of Coronel and Lota have been studied before, and are considered to belong to the Tertiary, or perhaps better the Upper Cretaceous. As one could imagine, that under these layers should appear more ancient strata with Glossopteris, I occupied myself during the first part of my stay with a close survey of the oldest layers reached in the mines, but could only find the same Arauco series. No trace of Glossopteris was seen. Large collections were made of marine and plant fossils, amongst which are ferns, Angiospermæ and Gymnospermæ."

RECENT EARTHQUAKES.

By R. D. OLDHAM.

In the February number of this *Journal* I pointed out the resemblances and analogies between the recent earthquake in Calabria and that of 1783, but in one point the resemblance was incomplete. In 1783 the earthquake was particularly violent and destructive in the interior; in the district round Oppido fissures opened in the ground, numerous changes of level occurred, and 215 lakelets, ponds, and marshes were formed by interruption of the drainage of the country. In the recent earthquake, though we heard much of the destruction of the sea-coast towns, nothing appeared in the daily papers regarding the interior of Aspromonte, and it almost seemed as if this might not have repeated the history of 1783, and might have escaped the ruin which fell on Messina and Reggio. Unfortunately, this was not the case; though the daily newspapers have said nothing, the *Hampshire Chronicle* has published a letter from a correspondent containing some very interesting extracts from the *Resto del Carlino*, which give an account of a medical mission, despatched from Bologna three days after the earthquake. Composed of doctors and medical students, to the number of sixteen in all, it seems to have been

the only relief party which left the sea-coast towns and struck inland to the communes of Oppido, Scido, and Delianova, where, according to the narrative of Dr. F. Cavazzi, they arrived on January 5, eight days after the earthquake, to find that they were the first to bring succour to this district. After attending to the wounded and ministering to their immediate wants, they left, thinking that they were only the first to bring help, not the only ones; yet everything was wanting there. As along the Calabrian coast and at Messina, ruin was widespread, most of the houses had fallen, those still standing were uninhabitable; the people who had escaped with their lives were living in the open or sheltering from the weather as best they might in old wooden sheds, in huts made of branches and grass, or under mats stretched on poles, or carts on end. This account serves at least to show that the earthquake was not confined to the straits of Messina, but was equally severe in the district which formed one of the centres of maximum violence in 1783; it also gives rise to a hope that some of the abundant and, it must be confessed, somewhat indiscriminate charity which has been poured out on the cities of the coast may find its way inland to the towns, whose need is greater though less known.

Apart from accounts of the great shock of December 28 last, the newspapers have frequent reports of earthquakes both in Italy and elsewhere. So far as the reiterated mention of fresh earthquakes in Calabria goes, the explanation is more human than physical; the citizens of San Francisco, who, in public meeting assembled, passed a unanimous resolution that there had never been an earthquake, were not likely to make much of the aftershocks which invariably follow a great disturbance, and discouraged, to the best of their ability, the transmission of news which might check the flow of commerce through their golden gate, but those of Reggio and Messina have no desire to stop the golden stream which is pouring from every quarter of the world upon their shores, and the earthquakes which occur are made much of, their magnitude is not depreciated, and we have heard of several which were nearly, and one which was said to be quite, as violent as the great one. Among the aftershocks there will certainly be one, if not more, of destructive violence, and that on the evening of January 23, which shook down several buildings still standing at Reggio, may, locally, have reached a degree of violence comparable with that of December 28; it was certainly bad enough to have done material damage and probably have led to loss of life had it stood by itself, but whatever its violence at Reggio, the limitation of the area over which it was severe shows that its real magnitude was small in comparison with the principal shock.

Not from Italy alone come the reports of earthquakes, but from every quarter of the globe; yet the great increase of earthquakes in the newspapers does not mean any corresponding increase in their real frequency. The phenomenon lies, in fact, within the province of the psychologist

rather than of the seismologist or geographer, and it is the destruction of Messina which has induced news agencies to report earthquakes, and newspapers to print the reports. Most of these refer to trivial and local earthquakes of no importance or interest in themselves; a few may deserve passing notice. On January 11 an earthquake was felt on the Pacific coast of North America, which did some small damage at Port Townsend, in Washington State, and was said to have been "severe" at Victoria, B.C. The region is one where earthquakes periodically occur, and is on the outskirts of one of the principal centres of earthquake activity of the world. On January 13 the whole of northern Italy and parts of the Tyrol were shaken by an earthquake, which was certainly felt from Triest to Genoa and from Trient to Siena, but did no damage except to a slight extent near Bologna. On January 19 an earthquake in Asia Minor destroyed many houses, and caused some deaths at Phocœa, Cassaba, and Menemen; this again is a region where earthquakes are not infrequent.

The most important, however, is one whose origin lay in the Luristan province of Persia, about two days' journey from Burujird, where some fifty villages are said to have been affected and 5000 lives to have been lost. Though it occurred on January 23, news only reached Europe on February 18, but it had been reported in the daily papers as a distant earthquake of unknown origin, recorded by the seismographs in Europe, India, and at the Cape of Good Hope, which was sensationally reported to be as "great as Messina," and this appears to be about its real greatness. The records reported in the papers showed that the origin must have been somewhere in Western Asia, along a line running about north-north-eastwards, to the east of the Caspian sea, but did not permit of its being more closely located, for the seismograph at the Cape of Good Hope evidently failed to pick up the first preliminary tremors of the disturbance. As time went on and nearly a month elapsed before the place of origin was fixed at the southern extremity of this line, it seemed probable that the centre lay in the deserts east of the Caspian, where there is plenty of room for an earthquake no greater than the Calabrian one to have escaped notice or record; for although this was a great world-shaking earthquake, of what may be called the first order of magnitude, it was among the smallest of that order. We have, unfortunately, no real standard of comparison of the magnitude of different earthquakes; the true measure should be, not the local violence of shock, still less the money value of the damage done or the number of lives lost, but the energy liberated by the disturbance, or the work done, and this energy we have no means of measuring. There is, however, good reason for supposing that it is proportional, even if not directly proportional, to the area over which the shock could be felt, or the seismic area, as defined by Robert Mallet, and as this area can usually be determined with approximate accuracy, we have a

means of ranging earthquakes in order of precedence of magnitude which gives an idea of their relative importance. Judged by this standard, the Calabrian earthquake ranks far below many other historic earthquakes; the seismic area, including in this the area under sea, over which it might presumably have been felt had this been dry land, was not much over 90,000 square miles; the area, similarly calculated, for the Californian earthquake of 1906 was more than four times as great, and in the Indian earthquake of 1897—the greatest which has been subjected to detailed examination—the area was 1,750,000 square miles, or about twenty times as great as that of the recent earthquake in Calabria.

THE GEOGRAPHICAL DISTRIBUTION OF THE MEAN ANNUAL RAINFALL OF WALES AND MONMOUTHSHIRE.*

By GEORGE BRANSBY WILLIAMS, A.M. Inst. C.E.

THE various existing meteorological maps which illustrate the distribution of the annual rainfall over Wales and Monmouthshire, being drawn to comparatively small scales, do not do more than show the broad outlines and approximate positions of the wetter and drier areas. A detailed and accurate rainfall map of the Principality is very much wanted, and the statistics referring to this subject, which have been steadily accumulating for the past forty years, have now reached a point at which they render the compilation of such a map possible; for although the information available at the present time is not sufficient to enable us to fix the isohyets (or lines of equal rainfall) with absolute accuracy in all parts of the country, they can be located with confidence in the greater portion.

At different times I have had cause to make investigations as to the amount of rainfall in various parts of Wales, and I have now included the whole of the country, and brought all the figures up to date. The process has been a somewhat laborious one, but I have endeavoured as far as possible to insure the accuracy of the calculations which form the data from which the map accompanying this paper has been compiled. This map shows the geographical distribution of the rainfall in greater detail than any map hitherto published.

The physical causes for the high rainfall over the greater part of Wales are well known. The moisture-laden winds from the Atlantic blowing up the numerous valleys which intersect the land between the mountain ranges and the sea, and which in the majority of cases on the south and west coasts run in the direction of the prevailing winds, are met at the upper ends by the steep slopes of the mountain sides, causing the air to rise suddenly, sometimes as much as 1500 to 2000 feet. The consequence is a heavy precipitation of moisture on the summits and on the lee sides of the ridges. This heavy rainfall takes place in some instances, as on the mountains of Carnarvonshire and Merionethshire, within a few miles of the sea; but on the Fforest Fawr and Brecon Beacon ranges in South Wales, and on the mountains of Mid Wales, the distance of the high lands (and consequently of the wet areas) from the sea is considerably greater.

Although a large number of gauges have been kept at various times in Wales and Monmouthshire, they have been very unevenly distributed and the records are

* Research Department, January, 1909. Map, p. 352.

in many cases short ones. In certain portions of the country, for example the district round Cardiff, the thickly populated area between Pontypridd and Merthyr, including the Rhondda valley and Aberdare, the southern slope of the Brecon Beacons, and in the district between Denbigh and St. Asaph, there are, or have been, gauges to the number of two or three per square mile. On the other hand, in the northern half of Carmarthenshire and in parts of North Wales there is a great scarcity of gauges.

On the whole, however, there are enough records in almost every part of the country to enable the mean annual rainfall to be determined with approximate accuracy; but it is necessary to make use of a number of short records, and to standardize them by comparison with other adjoining gauges at which the records are long and reliable.

For this purpose I have divided the whole of Wales and Monmouthshire into districts, arranged as far as possible so that the climatic conditions in each should be fairly similar; and the average of the three or four gauges with long continuous records has been used in each district for standardizing purposes. Thirty-five years have been assumed to be the length of time which gives a true mean annual rainfall; the actual periods chosen being from 1872 to 1906 inclusive in North Wales, and 1868 to 1902 in South Wales and Monmouthshire. A number of gauges had previously been standardized to the means for these respective periods, and the difference between the two means was found to be only an average of 0·15 per cent. To all intents and purposes, therefore, it may be said that every record made use of has been standardized to the same mean.

The method of correcting a short record, by computing the mean annual rainfall at the station from a long record, or the average of several long records, at adjoining stations, is a well-known one; but, although it has been so largely used, there does not appear to be any definite information available as to the probable accuracy of results obtained in this way.

I have made a number of experiments in order to find out, as far as possible, how far such results could be relied upon. For this purpose a number of gauges with long and apparently accurate records were selected, and the means computed from the standard gauges of the district in which the gauges were situated; first taking each single year of the experimental records separately, and then taking periods of two, three, four, five, and ten consecutive years. The calculated results were compared with the actual means at the gauges and the error expressed in terms of percentage of these means. The figures were taken from gauges purposely chosen so as to vary as much as possible in position, and in quantity of rainfall recorded, and about 500 observations were made. The averages of the results are given below.

TABLE SHOWING AVERAGE PERCENTAGE OF ERROR OBTAINED IN CALCULATING MEAN ANNUAL RAINFALL FROM SHORT PERIODS.

Length of record.	Average error.	Percentage of results with error of more than 20 per cent.	Percentage of results with error of between 15 per cent. and 20 per cent.	Percentage of results with error of between 10 per cent. and 15 per cent.	Percentage of results with error of between 5 per cent. and 10 per cent.	Percentage of results with error of less than 5 per cent.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1 year ...	8·03	5·4	9·1	11·4	36·1	38·0
2 years ...	6·59	3·0	5·1	13·1	27·3	51·5
3 „ ...	5·29	nil.	1·3	11·7	29·9	57·1
4 „ ...	4·59	nil.	1·5	10·1	23·2	65·2
5 „ ...	4·32	nil.	nil.	7·9	22·3	69·8
10 „ ...	2·96	nil.	nil.	nil.	18·0	82·0

From this table it will be seen that the mean annual rainfall computed from a record extending over ten years or more may be accepted with very little question. The average error was less than 3 per cent., whilst more than four-fifths of the observations had an error of less than 5 per cent., and there were no errors at all over 10 per cent. Means calculated from four and five-year periods gave results which in the majority of cases had errors of under 5 per cent., whilst even records for one single year gave results in which the error was less than 5 per cent. in nearly two-fifths, and within 10 per cent. of the true mean in three-quarters of the cases worked out.

The table shows, however, that means computed from periods of less than four years must be accepted with caution. The maximum error obtained in the case of a single year's record was 33 per cent., and for a two-year period 22 per cent. There is, moreover, an increased probability in the case of a very short record of the observations having been carelessly and inaccurately made. The districts into which the country was divided had necessarily to be rather extensive, owing to the comparatively small number of long records in Wales and Monmouthshire, and the examples chosen for the experiments were purposely sometimes far away from the standard stations. If it had been possible to divide up the country into smaller districts, the average results would undoubtedly have been more accurate.

Having decided the probable limits of inaccuracy, it was possible to proceed with the investigation with confidence. The total number of districts was seven, and for each of these three or four long records were obtained. The ratio which the rainfall of each year had borne to the thirty-five years' mean was worked out for every year at each station, and expressed as a percentage, and the average percentage taken of the three or four stations in each district. Every gauge in the district with a record of less than thirty-five years was then corrected from these averages.

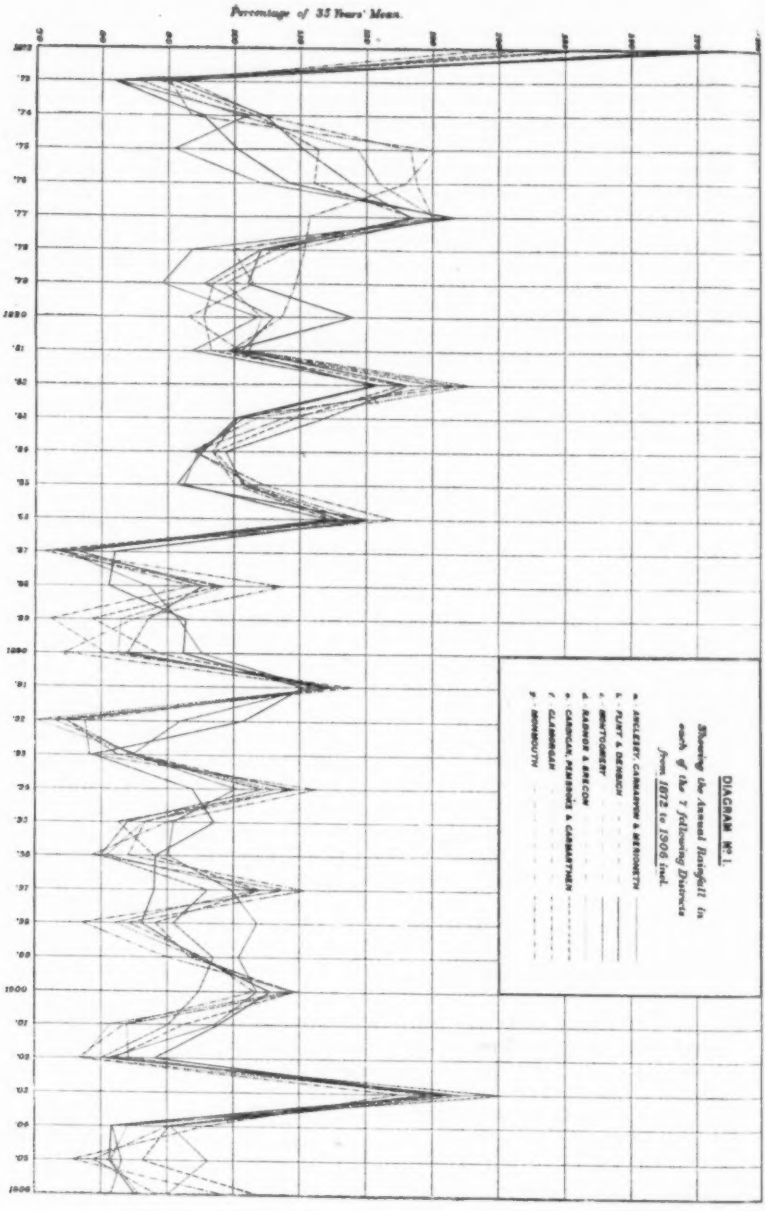
The seven districts were: (*a*) Anglesey, Carnarvon, and Merioneth, (*b*) Flint and Denbigh, (*c*) Montgomery, (*d*) Radnor and Brecon, (*e*) Cardigan, Pembroke, and Carmarthen, (*f*) Glamorgan, (*g*) Monmouth.

Diagram (1) shows graphically the relationship between the fluctuations in the annual rainfall in these seven districts between 1872 and 1906. Diagram (2) shows the average of the seven districts, and also the average annual rainfall during five and ten-year periods. It may be taken as showing the average variation from the mean over the whole of Wales and Monmouthshire. The ordinates of the curves are measured in both diagrams as percentages of the thirty-five years' mean.

The remarkable thing about diagram (1) is that the curves should, on the whole, show as close an agreement as they do over so wide an extent of country. In some years there are considerable divergencies; for instance, 1875 was a wet year in Monmouth, but was a comparatively dry year in Anglesey, Carnarvon, and Merioneth, whilst in 1898 the position was reversed, and in 1892, which was an extremely dry year in Radnor and Brecon, the rainfall was above the average in Flint and Denbigh. On the other hand, in 1873, 1877, 1881, 1884, 1886, 1887, 1891, 1893, 1900, and 1903 the results are sufficiently close to be remarkable.

1872 was easily the wettest year. In that year the average rainfall over the whole country was 155·83 per cent. of the mean; the next wettest was 1903, when it was 132·13 per cent. The driest year was 1887, averaging only 75·05 per cent., and the second driest 1892, with 80·48 per cent.

The driest series of ten years shown was from 1887 to 1896, when the annual rainfall only averaged 89·56 per cent. of the mean. For the ten years 1872 to 1881 the average annual rainfall was 110·65 per cent. The fifteen years 1872 to 1886 had an average annual rainfall of 110·14 per cent., and the fifteen years 1887 to 1901 91·44 per cent. of the mean.


Percentage of 35 Years' Mean.
DIAGRAM Nº 1.
Showing the Annual Rainfall in each of the 7 following Districts
From 1872 to 1906 incl.
a. ANGLESEY, CARNARVON & MERIONETH
b. FLINT & DENBIGH
c. MONTGOMERY
d. RADNOR & BRECON
e. CARDIGAN, PEMBROKE & CARMARTHEN
f. GLAMORGAN
g. MONMOUTH

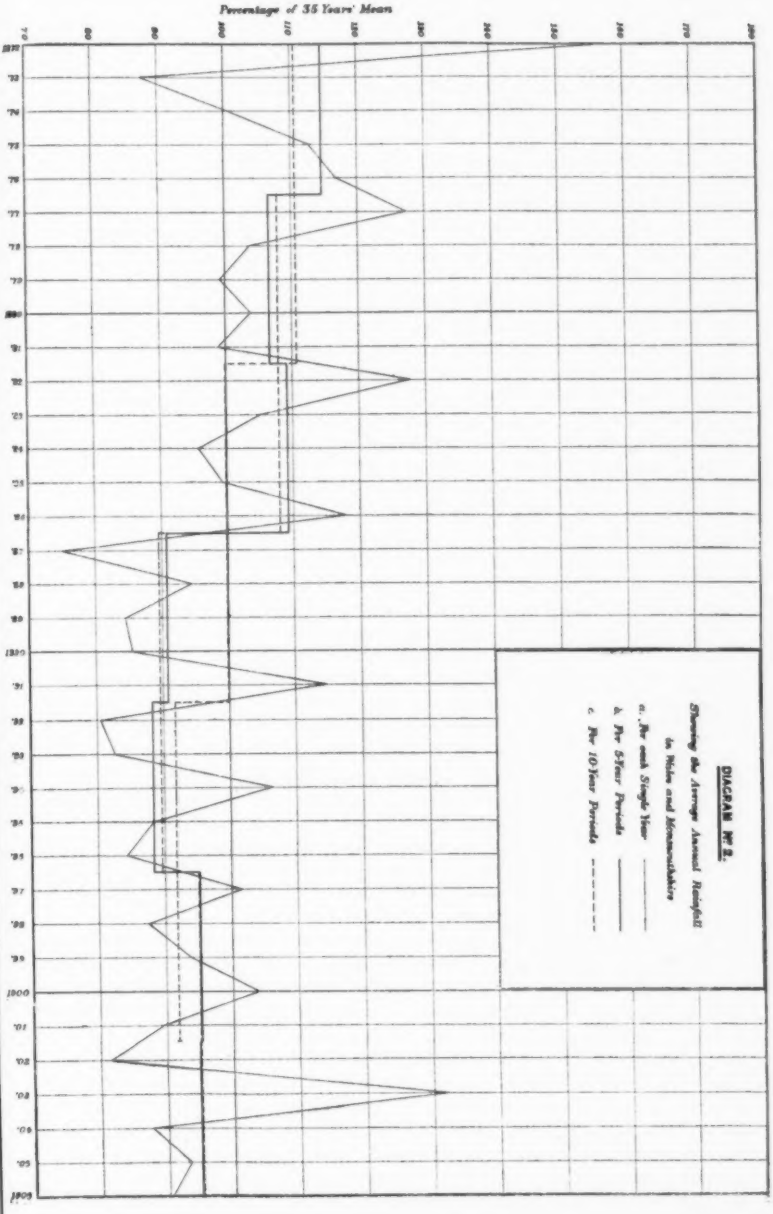

Percentage of 35 Years' Mean
70
80
90
100
110
120
130
140
150
160
170
180
1870
72
74
76
78
80
81
82
83
84
85
86
87
88
89
1890
91
92
93
94
95
96
97
98
99
1900
01
02
03
04
05
1909
DIAGRAM Nº 2.
Showing the Average Annual Rainfall
in Wales and Monmouthshire
a. Per each Single Year
b. Per 5-Year Periods
c. Per 10-Year Periods

DIAGRAM Nº 1.

The figures for the rainfall have been taken from the returns given annually in 'British Rainfall.' These have been tabulated for each year from 1868 down to 1906, omitting any particular return which Mr. Symons or Dr. Mill has queried as being possibly inaccurate. In addition, some use has been made in one or two instances of figures obtained from gauges not recorded in this annual. The mean annual rainfall was calculated for every gauge, and the figures were then plotted on a map to a scale of about 4 miles to the inch. The figures have been carefully scrutinized, and whenever a gauge having a short record has shown any discrepancy when compared with more reliable neighbouring gauges it has been disregarded. Between 500 and 600 records have stood this test; of these 205 are of a total length of ten years and upwards, and 380 of over three years. Of the figures used at least three-quarters should be within 5 per cent. of the true mean, and practically all the remainder within 10 per cent. It should, however, be mentioned that the very wet stations in the Carnarvonshire and Merionethshire mountains have in most cases records only extending over from one to three years; it is therefore possible that further information may somewhat modify the figures arrived at so far for this district, which is such an important one from a meteorological point of view.

The very wet areas shown on the map are in the positions which would be expected from the configuration of the ground and the direction of the prevailing winds. Taking them in order and commencing from the north, the Carnarvonshire mountains and the mountains in the portion of Merioneth north of the Mawddach river form two semi-detached wet areas. The portion of the Carnarvon mountains within a radius of about 2 miles from the centre of Snowdon receives an average rainfall of more than 150 inches per annum, and contains the wettest spot at which a gauge has hitherto been kept in Wales—Glaslyn, on the lee side of the summit and within the Snowdon crater—the mean rainfall here being apparently 197 inches per annum. An area of about 167 square miles on these mountains, in the shape of an equilateral triangle, has a rainfall of over 100 inches per annum. In Merionethshire there is at present no actual proof that the rainfall on the Rhinog mountains is more than 100 inches, although there is no reasonable doubt as to this. The valley of the Prysor appears to interpose a short width of country with a rainfall of less than 80 inches between these two districts, but the 70-inch area seems to be continuous over the mountains of Carnarvon and Merioneth.

On the south-east side of the valleys of the Mawddach and the Dee there is a narrow strip of wet country following the range of mountains extending from Cader Idris to the north-east end of the Berwyn range. The maximum fall on these mountains, which would naturally take place on Cader Idris itself, has not yet been determined. Further south a small area on Plinlimmon has a rainfall of over 90 inches, and in South Wales the mountains in the north-west corner of Breconshire have a rainfall of over 80 inches.

The 60-inch area is of irregular shape and very extensive, and covers the greater part of North Wales, stretching from the far end of Carnarvonshire on the north to below the point where the three counties Brecon, Cardigan, and Carmarthen meet on the south, and from above Pwllheli on the west to within 4 or 5 miles of Llangollen on the east, the maximum width being 33 miles, and the total length from north to south about 80 miles.

Between this and the wet country around the mountains of South Breconshire and Glamorganshire there is a drier strip following the line of the valleys of the Towy and Yrfon; but the rainfall in most of the country is only a little below 60 inches, and it is probable that there are a series of small patches with higher rainfall along the boundary between Breconshire and Carmarthenshire.

The Fforest Fawr and Brecon Beacons ranges have in places a rainfall of over

100 inches, but it is doubtful if the wettest spot in these mountains has been as yet discovered. The positions of the isohyets on the south slopes of the Brecon Beacons can be accurately located, thanks to the excellent system of rain-gauges established by the engineers of the Cardiff and Merthyr waterworks, but on the western end of the range the rainfall is more a matter of conjecture. A certain number of gauges have been kept for several years on the watershed of the Cray reservoir, but the results have not been published in 'British Rainfall.' From a paper read before the Swansea Scientific Society some years ago by the Swansea waterworks engineer, it appeared that the rainfall at the Bwlch pass, between the two mountains Fan Gehirach and Carmarthen Fan, is the heaviest recorded in South Wales, the mean annual fall being somewhere about 130 inches. It is quite likely that other parts of this range have an even higher average.

There have been a number of gauges kept in the Rhondda and Taff valleys in Glamorganshire, and the rainfall in the whole of this district is comparatively clearly determined. A small area on the summit between the Avon, Neath, and Rhondda valleys has a rainfall of over 90 inches; the 80-inch area includes the upper part of the Rhondda valley, and the 70-inch area practically the whole of that valley down to Pontypridd. The 60-inch isohyet encloses in its serpentine course the south-west corner of Breconshire, the high land in the centre of Glamorganshire, and small portions of Carmarthenshire and Monmouthshire. A curious feature is the loop made by this line on the north-east side of the 60-inch area, taking in Sirhowy, Merthyr, and Aberdare.

In Pembrokeshire, a small part of the country around Mynydd Preceley has a rainfall of over 60 inches, and the 50-inch rainfall area forms part of an extension through Carmarthenshire from the wet district in the centre of Wales. In Carmarthenshire, the 50-inch isohyet follows the south side of the Teifi, and outlines the low-lying land along the valley of the Towy as far as Llandovery.

Following the west and south coasts from the mouth of the Conway to the mouth of the Usk, there are narrow strips of land of varying width, with a rainfall of under 40 inches. Over the greater part of Anglesey the rainfall is less than 40 inches. The coast of Flint has a rainfall of under 30 inches.

Along the Welsh border the 30-inch isohyet pursues a course almost due north and south from Hawarden through Wrexham into Shropshire. It reappears in Montgomeryshire, passes round Montgomery, and finally crosses the border near Bishops Castle.

The 40-inch line runs in an east-south-easterly direction from the north of Carnarvonshire near Conway for over 20 miles, and then forms a **V**-shaped loop. which includes Corwen. From a sharp angle, about 4 miles west of Wrexham, its course is south and south-west through Llangollen and close to Llanfyllin. A loop includes Newtown and the valley of the Severn almost as far as Llanidloes. From this point the line runs almost due east to a right angle near Knighton and old Radnor. An irregular series of curves takes in part of the valley of the Wye, and Llangorse lake in Breconshire, and the Black forest mountains are enclosed by an **S**-shaped bend. After passing through Abergavenny, Newport, and Cardiff, the 40-inch line finally ends in the sea between Bridgend and Aberavon.

Along the east side of the country the 50-inch isohyet follows, with some exceptions, the general line of the 40-inch. For the greater part of the distance the two lines are from 2 to 6 miles apart, but in Radnorshire they are separated by almost the whole width of the county. A curious feature in this county is an irregular patch of dry country around Llandrindod Wells, with a rainfall of under 40 inches.

The Black forest mountains in Breconshire and Radnor forest do not appear to

have an exceptionally heavy rainfall, although in neither instance is there any definite information as to the maximum.

Generally speaking, although the isohyets shown on the map may require slight alterations in some parts of the country, there is no doubt about their positions, within a mile or so, in most places. They bear an obvious relationship to the contour lines, but it is by no means a constant one, and an exhaustive investigation has been unable to discover any possibility of expressing this relationship in comparative figures for rainfall and altitude, either on the windward or the lee side of the country. The reason for this is the irregular configuration of the ground in the greater part of Wales. The shapes and positions of the mountains and the local air currents often cause the isohyets to be in entire unconformity with the contour lines over short distances, so that amongst the higher mountain ranges two adjoining places may be within a few feet of the same level, and receive a rainfall differing by quite 40 per cent.

The districts in which there is a scarcity of rain-gauges have many of them been already referred to. Carmarthenshire is the worst county in this respect. Gauges are particularly required on the Carmarthen Fan, along the Breconshire boundary, and on the hills in the northern half of the county.

Cardiganshire is also poorly provided with gauges; and other places where recording stations are required are the Cader Idris and Berwyn ranges, the mountains north of Dolgelly in Merionethshire, in the western part of Montgomeryshire, and also on Radnor Forest and the Black Forest mountains. A few gauges judiciously placed in these several districts would in a short time add considerably to the information existing on the subject.

An accurate knowledge of the distribution of the rainfall in the various parts of Wales is of great practical value from an engineering point of view. Apart from questions of water-supply, which is already derived from the Welsh mountains by various large towns, and which it is probable other towns, including London, will wish to obtain from the same source in the future, there is also the possibility of a limited amount of water power being used for generating electricity, in places where the natural conditions are especially favourable. There are, in fact, already two or three power stations in North Wales, making use of the fall between the mountain lakes and the sea for this purpose.

It does not come into the scope of this paper to enter in detail into engineering questions, but I may mention that I have recently estimated that, outside the watershed areas already appropriated for the supply of towns, and omitting all land clearly unsuitable for the construction of waterworks, there are about 1300 square miles above the 600-foot contour line which it would be physically possible to utilize as catchment areas by constructing impounding reservoirs or employing natural lakes already existing. The mean annual rainfall over the 1300 square miles has been worked out, and it is found that, after deducting the inevitable loss from evaporation and absorption, and also the water which it would be impossible to store in normal-sized reservoirs, a daily quantity of 1,750,000,000 gallons could be furnished by these 1300 square miles, or enough to supply 58,000,000 persons at 30 gallons per day.

In order to make this quantity available, however, a very large number of reservoirs of all sizes would have to be constructed at great cost, and it is safe to say that nothing like this amount of water will be supplied from Wales for drinking purposes until the conditions of life in this country become very different from those at present obtaining.

If the energy of the water stored were utilized for power-generation instead of water-supply, about 225,000 effective horse-power could be generated during

ten hours per working day throughout the year, but the cost would be prohibitive in many places. I have estimated the limit of the possibilities of Wales as a water-power producing country under the present conditions (that is, as long as the supply of coal lasts) at between 40,000 and 50,000 effective horse-power during each working day throughout the year.

There are many other points in connection with this subject which it would be possible to elaborate to an indefinite extent, for Wales and the border counties offer exceptional opportunities for the study of problems in connection with rainfall, the solution of many of which might have a wider application. I have, however, purposely confined myself in this paper to within narrow limits, the object being the publication of the accompanying map, with a general description of its main features, and the system on which it has been compiled, and also a brief indication of a few points of interest on which the subject of the rainfall of Wales has a direct bearing.

Dr. STRAHAN: The paper for this afternoon's meeting is "The Geographical Distribution of the Mean Annual Rainfall of Wales and Monmouthshire," by Mr. G. B. Williams, and I will ask the author to read such part of it as may be essential for the purposes of discussion.

Dr. STRAHAN (after the paper): This paper has not taken long in delivery, but I think you will agree with me that it contains internal evidence of much work and trouble. The subject is now open for discussion, and I will ask Dr. Mill to make some remarks upon it.

Dr. MILL: I have given a good deal of attention to the preparation of rainfall maps, and I should have been much interested if Mr. Williams had said something about the method he employed in drawing the isohyetal lines. Perhaps he will be able afterwards to give us some light on one or two points to which I shall refer presently. But in the first place, I must express my gratification that this Society has accepted a paper on this subject. The distribution of rainfall is in a special sense geographical, for rain is one of the few elements of climate which bears an extremely intimate relation to the configuration of the land. I am glad to find how skilfully Mr. Williams has prepared this map. It is a difficult thing to test the data and, after placing the figures on a map, to draw the isohyetal lines with confidence, and he seems to have succeeded well. Numerous and accurate observations are indispensable as a foundation for all map-drawing. We are still very much in the dark with regard to the rainfall over considerable areas of the interior of Wales, and it may be that when we get more information about these areas, our views of the districts where there are already a fair number of rain-gauges may be somewhat modified. I quite agree with all that was said about the need for more gauges, and as Wales is a country of such varied configuration, it requires a relatively greater number of rain gauges than would suffice in the flatter country of the centre of England. With regard to the thirty-five years' mean, I am not quite clear whether Mr. Williams means that he himself assumed that as the period that would give a true mean, or that the general use of thirty-five years as a sufficient period is an assumption. A thirty-five years' mean has been proved to be necessary and sufficient by the classical paper of Sir Alexander Binnie on "Mean or Average Rainfall," published by the Institution of Civil Engineers in 1892, and by the researches of Prof. Hann and other investigators.

One very valuable thing in this paper which, as Mr. Williams says, is quite new, is the statement showing the average percentage of error in calculating the mean annual rainfall for a long period from short records. This is a subject of which, unfortunately, I have much experience, and there are curious differences in the

relative rainfalls of contiguous stations between one year and another. Sometimes all the rainfall stations in a small area will vary proportionally with one another for a period of four, five, or six years, but then a period of five or more years may occur in which the ratios are completely upset. Diagram No. 1 deals with averages for considerable areas, and therefore smooths down the irregularities which would be shown by individual stations, still it shows the occurrence of disturbed periods. In dealing with the ratio from a short to a long record, it is of the first importance that the short record should concern a group of years in which the ratios to the long average of a number of neighbouring stations agree with one another. It is not always possible to secure such a result, and this is probably the principal reason why the longer the short record is the better is the estimate of the computed average. One of the chief difficulties in dealing with long records lies in the fact that observers were formerly much less careful than they are now in entering the observations in a uniform manner. As a rule an inconsistency in entering does not matter, but on the few occasions when a very wet day occurs on December 31, and some enter the rain to that date and others to January 1, the result will be great confusion, one year in some cases may be credited with several inches less rain, and the next year with several inches more, at one place than at another. In the case of old records it was almost impossible to detect and correct this error before the figures were published in "British Rainfall," but now detection is almost certain before publication. The irregularities not produced by want of consistency in entering are probably due to a run of thunderstorms in some years, these thunderstorms being so patchy in their incidence that one place may get 3 or 4 or 5 inches more rain than another only a few miles away.

I do not think that it is right to suppose that short records are probably more careless and inaccurate than long records. I am afraid my experience goes to show that the longest records often become the worst, because they are not uncommonly kept by enthusiasts who began in middle life, and who have gradually acquired a belief, as their powers failed, that nobody but themselves can read a rain-glass. In the case of one old observer it was discovered that, as he grew more dim-sighted, in order to read the glass clearly he tilted it more and more towards him, and thereby got higher and higher readings, so that the record instead of really indicating an increase of rain measured only deterioration of eyesight. One of the chief troubles with long records is that they have a tendency to deteriorate from several causes, and the unfortunate thing is that the differences may take the form either of getting too much or too little; so that, before using these records, it is necessary to consider very carefully whether they have kept much the same level of accuracy throughout, or whether, if they have changed, it is possible to correct them.

I could have wished that a little more had been said about the map itself, because in a geographical gathering the distributional part of the subject is the one which acquires most interest. I consider this map of Mr. Williams's by far the best map of the rainfall of Wales that has yet been published; in fact, so far as I know, there are only two maps of the rainfall of the British Isles, and these on a small scale, which could be looked upon as dealing with the rainfall of Wales at all. One was published by Mr. Symons in the Report of the Rivers Pollution Commission of 1868, a long time ago, when there were few observers. The other map I submitted to the Institution of Civil Engineers in 1903. That map was intended to test the truth of the assumption that the rainfall had a close relation to the configuration of the country. The isohyetal lines were drawn upon a blank map without any rivers or marks to indicate the configuration of the country, and they were drawn in strict conformity with such observations as gave a thirty years' average. The

result was to demonstrate quite clearly that the distribution of rainfall on the whole bore a very close relation to the configuration of the land, so close a relation that, in my opinion, it is justifiable, in drawing a rainfall map now, to make the isohyetal lines run generally parallel with the contour lines when the interval between two observations is a fairly long one. In the much more detailed maps which I have prepared for the Water Supply Memoirs of the Geological Survey, especially the map of Kent, which has recently been published, it is found that this holds good in a remarkable degree, though the heights of the land are moderate. When we come to a mountainous region like Wales, where in some of the valleys there are many rain-gauges, it is found that one side of the valley may have 10 or 15 inches more rain than the other side, so that it is impossible to give a true representation of the distribution of rainfall on a small scale in so complicated an area. I had occasion a few years ago to make a very careful study of the rainfall of a portion of North Wales, but with the whole of the evidence at my disposal I could not satisfy myself sufficiently to publish the map, though it was sufficiently precise to serve the practical purpose for which it was made. On comparing that map by means of a tracing of the lines with Mr. Williams's map, I find that the accordance is, in some cases, very close indeed, and I believe that if the total volume of rainfall were worked out from the lines on my map, and also from the lines on Mr. Williams's map, the figures would be identical. But there are some differences in the run of the lines to dispose of which it would be interesting to get some additional data. Fortunately, the engineers of an electric company utilizing the water-power of Snowdon have set up a number of rain-gauges, and they have obtained some extremely interesting results, showing the enormous differences in the amount of precipitation within a very short distance in parts of the country where the relief of the land is very abrupt. The highest rainfall in the British Isles will probably be found to be somewhere on the eastern side of Snowdon, where it may work out at something near 200 inches. With regard to the central part of Wales, there are a good many waterworks, and the number of rain-gauges kept on them is, fortunately, increasing. One great difficulty I have had in collecting data from Wales is that there have been so many waterworks laid down there, employing so many paid observers, that it is not so easy to get voluntary unpaid observers as in other parts of the country.

There are some places where a great many more observations are required, chiefly in the mountainous region on the borders of Pembroke, Cardigan, and Carmarthenshire. The long area, with over 100 inches north of the Brecon Beacons on Mr. Williams's map, is an extremely interesting feature. The only station I know which gives returns that would justify a record of as much as 100 inches is near the Cray reservoir of the Swansea Waterworks, and that, as Mr. Williams suggested, has not appeared hitherto in "British Rainfall," though it will appear in the next volume. I feel inclined to doubt the extension of the 100-inch area beyond the immediate vicinity of the gauge in question. With regard to the Black Mountains in Monmouthshire and Brecon, there is no doubt that in the highest part of the mass the rainfall exceeds 55 inches. I think that all along South Wales we will find that the isohyetal lines must be much generalized, as they are here, before they can be shown on a map at all; as the rainfall of the numerous parallel valleys running north and south is very complicated. Again, in that part of the country there are frequently severe thunderstorms which produce tremendous falls of rain locally, affecting only small areas, and these must have a very disturbing effect on the ratios from which the calculations of the long-period average rainfall are made. While this rainfall map of Wales, within the limitations I have pointed out, is the best yet published, much work

must yet be done before we can, with perfect confidence, from the geographical point of view, relate exactly the depth of rainfall to the height and exposure of the land. I am at present making a series of maps of annual rainfall from 1908 to about 1865, and I hope to be able to combine the forty-five maps in such a way as to produce an average map, not based on a few long records, but on the whole of the records for each year. This should come nearer to a true map of the average rainfall than would be possible in any other way. The subject is one of supreme interest to me, and I am very glad to see the able manner it has been handled by Mr. Williams.

Mr. Baldwin Latham: I have not much to add to what Dr. Mill has already told us. I am certainly very much indebted to Mr. Williams for the information he has given us in this paper, and to Dr. Mill for the remarks he has made upon it. I have recently put up four rain-gauges on the Black Mountains in this district, so that in time we shall know something probably about the rainfall of that particular district. My own view is that the rainfall of that area is much over-estimated. We find a difficulty in fixing these rain-gauges on the mountains, and that the effect of wind often interferes with the record of the gauge, and the gauge gives much less rain than actually falls. As a matter of fact, in this very neighbourhood, on the drainage area of the Merthyr Tydfil waterworks, some years ago I worked out the actual quantity of water which was yielded in 21 years by the area, and it was found to be 75·5 inches flowing off the area, and when rain-gauges were put up within the area, and maintained there for a period of from 12 to 18 months, more water was gauged as flowing off the area than was actually caught by the rain-gauges. This in a great measure is due to the action of wind on a gauge preventing the entrance of rain. As I observed on one occasion on the Mourne mountains in Ireland, when during a snowstorm I watched a gauge which was fixed some four feet above the level of the ground, and I found that there was not a particle of snow falling into the gauge; it was all blown over. In all probability, in the case of gauges at these high elevations we should have to do as the Rev. R. P. Dansey has done with the gauge he has fixed on Waun Fach—that is, surround them with a turf wall so as to moderate those currents of air which cause the rain to sweep past and over the gauge. A proper record of rainfall is a very important matter to the country, and the more people take an interest in it and give us the records, the better it will be.

I wish to thank Mr. Williams for the very interesting paper which he has presented to us, but I may say from my experience of the neighbourhood that it will never pay to make an extended series of reservoirs in order to utilize the water-power, as the cost of the reservoirs in such a district would be more than the value of the water which would be secured.

Dr. Strahan: This paper has interested me greatly, for I have had occasion to spend a large part of the last twenty years in the region which is described, and I have had opportunities also of judging of the relative heaviness of rainfall in various parts of it.

The rain was often more or less localized, and its distribution accounts for much of what we have heard of the disagreement between contours and isohyetic lines in the course of this discussion. To mention one notable case, two rivers draining the same moorland open into a main valley close together; in one there was a violent flood, but in the other there was no flood whatever. This was attributed, not to a thunderstorm, but to what is called a "cloud-burst." I do not exactly know what is meant by that, but certainly there was a burst of torrential rain, which proved to be capable of producing disastrous effects, but which was strictly local in distribution.

With regard to the utilization of the rainfall for the purpose of water-power, I agree with Mr. Latham ; I do not think there is very much to be hoped from that. When the Royal Commission on Coal Supplies was inquiring into the possible sources of power apart from coal, one witness went very carefully into the water-question. He calculated that in Scotland, supposing that every river was utilized, the power would suffice to work the railways, but nothing more. But in practice not nearly the whole power is available, and in South Wales, the most that could be done would be the damming-up of some of the smaller tributaries, for the main valleys are occupied by towns, collieries, and works. Moreover, the water is required for other purposes; even a short drought reduces the valleys to an insanitary condition, and one welcomes the first shower which clears the rivers out.

I think you will agree with me that a paper of this kind has involved a great deal of labour and very careful observations, and that we are greatly indebted to Mr. Williams for bringing his results before us this afternoon.

Mr. Williams: Before replying to the various points raised, allow me to thank you for the very kind way in which you have received this paper. The labour spent on it is amply repaid by being permitted by the Geographical Society to publish the results in a way in which they will be more widely read than they would if published in any other way. I should like to repeat that the subject is treated from an engineering standpoint, and in rainfall questions, as in other scientific questions, I suppose the function of the engineer is not so much to enter into competition with the scientific man in his scientific investigations as to gather what is useful to himself from those investigations, and if possible to add from his own experience sufficient to fill up any gaps that he may find. In a question of this kind, the engineer is chiefly concerned with facts and figures, and how far other facts and figures can be deduced from them. I say this in order that it may be understood that I am not in a position to meet Dr. Mill on equal terms as a scientific meteorologist. I wish to thank Dr. Mill very much for the kind way in which he has spoken of my efforts, and I think that this paper will have been valuable as having elicited from him the remarks we have listened to this afternoon. I should also say that, in speaking of the areas in Wales in which there are no gauges, I ought to have mentioned that Dr. Mill has himself succeeded in filling up a good many gaps in the rainfall map in the last few years. With regard to the various points Dr. Mill has referred to, thirty-five years was taken as a standard, because of previous work which has been done by rainfall experts, and special mention should be made in this connection of the paper which Sir Alexander Binnie read before the Institution of Civil Engineers some years ago, in which he has proved this to be a period sufficiently long to give an accurate mean. It is, of course, quite true that during some periods rainfall curves at adjoining stations follow parallel lines, and during other periods do not. But the figures I have given are an average for a number of different years, and therefore take this into account. The point Dr. Mill raised about the last day of the year, the rainfall of which might go sometimes into one year and sometimes into another, is an interesting one, and I had an example. At our own gauge in South Wales there happened to be a very heavy fall of snow on December 30, and I found that the man who keeps the gauge proposed to leave the snow filling up the gauge until it thawed itself. The consequence would have been that it would have gone into the rainfall of January 2 instead of December 30, so that to that extent the rainfall record of our gauge would have been inaccurate for the years 1908 and 1909. In drawing the isohyetal lines as far as possible, every valley and every range of mountains has been carefully studied, and the lines have been drawn with due regard to the contours and

the prevailing winds. In North Wales I think that the lines may possibly not be quite so accurate as in South Wales, because the distribution is more complicated, and also because I cannot personally claim the intimate knowledge of North Wales I possess of the greater part of South Wales. Dr. Mill considers that long records are more likely to be inaccurate than short, and to a certain extent that is no doubt true, but my experience is that some people keep their gauge for one or two years and for about three-quarters of another, and the return for the last year is rather imaginary, and probably extremely inaccurate.

As to the heavy rainfall on the Black mountain range in South Wales, the gauge which has been relied on as showing that the area over 100 inches does extend to the eastward is a gauge which has only been kept for one year. It was kept at a place called Pen Milan, and from the record for that one year I make out that the mean is 10·6 inches. The spot is just over the ridge of the Brecon Beacons, where one would expect the highest rainfall in these mountains. It is interesting to find that the rainfall on the Black Forest has now been determined to be more than 50 inches; the information I had when this paper was written did not show what that rainfall was. I do not think that Mr. Latham's remarks require any reply from me. Of course the investigations he has made on flood-water discharges are well known to every member of the engineering profession. I quite agree with him that it could never pay to construct reservoirs for power purposes. At the beginning of last year Mr. Lloyd George asked me whether I could give him some information on that question. He at that time seemed to have rather an exaggerated idea of the amount of water-power that could be obtained from Wales, and I wrote a memorandum for him, and went into the subject fully, and found that the average cost of this water-power would have been about 1*d.* per horse-power, as against the cost of steam-power, taking coal at the price it was then—about 6*d.* per horse-power. On the other hand, I think there are certain places which have special natural advantages, where a certain amount of water-power could be generated for a cost of less than ½*d.* horse-power per hour.

I have been asked if there were any records on Cader Idris. As far as I recollect, there are no records on that mountain. There is one on Mynydd Precely, which is probably in about the wettest place. Major Darwin has asked me about the periodicity of the rainfall. Although it does at first sight appear from the diagram as if there were some signs of it, I hardly think there is enough evidence to generalize from. I think I have now answered all the questions which have been asked.

VOLCANIC GASES.*

It is generally held that steam is the most important of all the gases emitted by volcanoes. During an active eruption the explosions which take place within the crater, projecting ashes and lapilli to a great height in the air, are ascribed to the expansive power of superheated water; the clouds of "smoke" which hang above

* Albert Brun, "Quelques Recherches sur le Volcanisme," *Archives des Sciences physiques et naturelles*, Geneva, May, 1905, November, 1906, October, 1907, February, 1908.

G. Mercalli, 'I. Vulcani attivi della Terra.' Milan: 1907.

Armand Gautier, *Archives des Sciences physiques et naturelles*, Geneva. November, 1907.

Frank W. Clarke, "The Data of Geochemistry," *Bulletin of the United States Geological Survey*, No. 330. Washington: 1908.

the summit are supposed to be steam mingled with volcanic dust, and the white canopy which covers the moving surface of a flowing lava is regarded as steam given off as the molten rock cools and solidifies. We are also taught in the text-books that in a volcano during eruption there is practically nothing resembling combustion, and there are no real flames: a volcano is not really a "burning" mountain, but rather a steam engine, or a hot spring, of which the temperature is so high that the rocks are melted by the heat. Where the water comes from has been much discussed. Some suppose it is atmospheric and has filtered downwards from the surface; others favour the theory that the sea has found entrance to subterranean depths by means of open fissures; while others, who have many inferences derived from the study of plutonic rocks and ore deposits to support them, believe that the steam or its constituents, hydrogen and oxygen, are original in the magma, and belong really to the Earth's interior, not to its surface.

These hypotheses, so long accepted, are stoutly combated by M. Brun, a savant of Geneva, who is very well known for his work on minerals and rocks at high temperatures. He has conducted a long series of researches, partly in the laboratory, but also in the field, which prove, in his opinion, that a volcanic eruption is really anhydrous; water plays no essential part in it, and though water is often present it has only been accidentally introduced, and obscures instead of explaining the true state of affairs. In all lavas, according to this authority, certain substances occur, which, by their mutual interactions, generate gases, and these in turn produce the explosions. These generators are (1) certain nitrides (of silicon and iron), (2) hydrocarbons, (3) natural chlorosilicates, especially of lime. The gases given off by these are chlorine, nitrogen, and volatile hydrocarbons. By combining with one another and with oxygen they can produce ammonia, hydrochloric acid, ammonium chloride, carbon monoxide, and carbon dioxide, and lastly traces of water. Most of the water, however, which is found in fumaroles and in ash beds is atmospheric water, which has filtered downwards from the surface.

A theory so revolutionary as this requires substantial proofs, and M. Brun has spared no pains to obtain these. He has found that igneous rocks, when heated in a crucible, yield ammonium chloride, nitrogen, hydrocarbons, and other gaseous substances. When lavas are fused artificially these gases are discharged at the moment of fusion (temperature 875° to 1000° Centigrade), and explosions are produced. Conversely, as a crater cools down it will emit gases in a definite order, corresponding to the reactions which take place between the generators themselves and between them, the lava, and the atmosphere. He has also visited many active volcanoes during periods of eruption (Etna, Vesuvius), and has made observations on their solid and gaseous products. A special trip was taken to Teneriffe, where he has succeeded in proving that the fumaroles of Lanzarote contain practically no vapour of water. Lastly, he has made experiments by mixing volcanic rocks with the "generators" above enumerated, and has obtained reactions similar to those which take place during actual volcanic eruptions.

As might be expected, these views have met with a good deal of adverse criticism. Mercalli, Gautier, and others have brought forward arguments to undermine M. Brun's position. Gautier in particular has written much about volcanic gases, and takes a diametrically opposite standpoint. He regards water as most essential; in fact, he believes that by the action of water at high temperatures on the natural silicates and other minerals of igneous rocks most of the known volcanic gases may be generated. As indicated by Clarke, the balance of geological and chemical opinion inclines in Gautier's favour, though it is not necessary to accept all his hypotheses in full. Meanwhile the controversy goes on vigorously, and shows no signs of coming to an end.

We may well feel sceptical about the enormous "pine-tree" cloud of Vesuvius consisting of ammonium chloride, as M. Brun supposes, when up to this date no other observer has suspected it. It is quite certain that in many cases volcanoes and fumaroles give off much steam, though the percentage of other gases present may quite possibly have been underestimated. Above all, seeing that oxygen forms about one-half of all rocks, and all the commoner elements which occur in the lithosphere are in the oxidized condition, it is strange that there should not be enough of this element to combine with part, at least, of the hydrogen and produce water. There are many facts connected with mineral deposits which show that in cooling, deep-seated, plutonic, igneous masses discharge enormous quantities of water; and if this substance be present in the molten magma, however it may have been introduced, it cannot be supposed to play a merely passive *rôle* when we remember the very high temperatures and pressures at which eruptions take place.

J. S. F.

REVIEWS.

EUROPE.

Old London.

'Memorials of Old London.' Edited by P. H. Ditchfield. 2 vols. London: Bemrose & Sons. 1908. *Price* 25*s. net.*

Mr. Ditchfield has called together a body of excellent authorities on London history, including Mr. Loftie, Mr. Sands, Mr. Clinch, Mr. Fairman Ordish, Mr. Wheatley, Mr. Philip Norman, Sir Edward Brabrook, and others, to write on various phases of London life, apparently as an incentive to the understanding of the London pageant. Excellent and, indeed, valuable as these articles are, they do not seem to answer their purpose, and we are bound to add that the editor does not seem to have much idea of how that purpose should be answered. In the first place, his own contributions to the volume are inadequate, and accuracy, so essential in an editor, is not conspicuous in Mr. Ditchfield's case. To reproduce Norden's well-known map of 1593 accurately and well, and with the date of the map clearly indicated on it, and then to inscribe it as "a plan of London in the time of Queen Elizabeth (1563)," and in the list of illustrations to add the information "from an old print" is an example of faulty editing altogether inexcusable, especially as in the only article where the map is used, that of Mr. Ordish, it is, of course, properly quoted. To faulty editing is added faulty writing, and the skimming over the surface of things in an article entitled "The Pageant of London" is not worthy of the rest of the book.

The rest of the book is extremely interesting, and the illustrations are charming, Mr. Norman's coloured drawings being really delightful, and the reproductions from old prints well chosen and well executed. Mr. Loftie repeats in a rather thin article his well-known theories about early London. There is nothing of Roman London left. There was not much of Saxon London to leave. London sprang into life somehow and somewhen. We cannot subscribe to this wholly inadequate theory, though we acknowledge the authority with which Mr. Loftie speaks on his lifelong study. This opening article is followed by a series on special subjects. We begin to feel the disjointedness of the volume at this stage. Mr. Sands on the Tower is extremely interesting, but there is not much that is new told us about this venerable building. Mr. Tavenor-Perry on Bartholomew's the Great, on the other hand, is putting Londoners into possession of facts concerning the remains of its most beautiful

church only just in time to have those remains jealously guarded from destruction. The Charterhouse, the Temple, the Inns of Court, the Guildhall are next treated of, and these features of London remaining to us now are interspersed with articles on the City companies, Hanseatic League, and the City arms. Mr. Ditchfield introduces into his sketch of the City companies an illustration of Furnival's Inn in 1804, another example of his curious notion of editing. Mr. Mylne's article on the palaces of London is distinctly useful, though we do not understand why a short disquisition on the "martyrdom" of Charles the First comes in here. Mr. Mylne has, on the other hand, missed the important point of the palaces of the sovereign being outside the City and not within it, and he should have carried his researches a little closer into Bridewell and other places in order to illustrate this important subject. Mr. Ordish's article on Elizabethan London is really good. It is expansive and commanding. It deals with its subject, and does not play around it. It does not waste words on meaningless explanations of small points. To London topographers and students of maps it will be found to be of real service, for it acts as a guide, and we willingly follow the survey thus set before us. Mr. Wheatley on Pepys' London is of course good, and we travel about with him from place to place as the great diarist commands. We think the illustration of a "portion of an exact survey of the streets, lanes, and churches," December, 1666, unaccountably placed opposite to p. 8 in vol. 2, would have properly illustrated Mr. Wheatley's notice of the Fire on p. 79. Mr. Tavenor-Perry on the bridges gives us a most useful summary, but his modest description of some of them as "frankly utilitarian" does not convey an idea of the hideous monstrosity which takes us from Westminster to Lambeth Palace! The clubs, coffee-houses, and literary shrines are dealt with, but surely Miss Elsie Long should have referred to the historic houses now being marked all over London.

There is much in these volumes which the general reader will gladly possess, and some few things which the specialist will welcome, but it does not appear to fill a gap, it does not illustrate the pageant, which is its special purpose, and we feel that the sporadic collection of articles, however ably done individually, does not compensate for the omission—the fateful omission—of a plan or scheme which will carry the reader forward from one stage to another of the subject-matter.

G. L. G.

ASIA.

An Austrian Explorer in Tibet.

'Eine Reise durch Zentral Asien im Jahre 1906.' By Dr. Erich Zugmayer. Berlin: Dietrich Reimer (Ernst Vohsen). 1908. 12 *marks*.

To those who are familiar with travels in Central Asia, the most interesting part of Dr. Zugmayer's story is that which relates to Tibet. Making Polu his starting point for his attack on the Kun-lun mountains, he followed up the valley of the Kurab Su to its source, and then, striking east from the pass (5850 metres), descended the mountain-side, in spite of its precipitous character, towards the Keria Daria. The journey was so difficult that one part of the route, only 4 kilometres long, entailed ten hours of arduous labour. Then advancing from Baba Hotun, in the Keria valley, towards Lake Markham, the party, after climbing to a height of 5950 metres, found it impossible to proceed further, as their animals could not stand on the slippery ice, which extended to the col (6100 metres). In one night five animals succumbed from cold and exhaustion, and a retreat had to be made the next day towards the valley. Escape from the valley for a time seemed hopeless, and at last, abandoning the attempt to proceed further eastwards, the expedition made its way to Lake Apo-zo (Aport-tso). On the way Dr. Zugmayer found that the headwaters of

the Keria valley consist of two considerable streams, and not of several branches as his maps showed.

In the six weeks occupied in reaching the lake, over two-thirds of his animals had died from exhaustion or accidents, and Dr. Zugmayer found it necessary to abandon a large quantity of his stores and to send messengers to seek for some Tibetan encampment from which other animals could be bought, no matter at what price. Meanwhile he occupied himself in mapping out the lake and investigating the natural history of the region. At last his messengers returned, but with only three yaks, and he had to resign himself to curtail his projected journey and travel eastwards.

On leaving Apo-zo he proceeded to Mangzaka lake, and striking southwards came for the first time into contact with Tibetans, from whom later on he was able to buy yaks and ponies for his train. But word was sent on ahead to Rudok of his approach, and on his arrival at Noh he received a message that he must return from Tibet by the way he had come, and that no provisions were to be supplied him until he started back. After some days he prevailed on the Governor of Rudok to allow him to proceed to Leh, but this was only on condition that he did not visit Rudok on the way, and was attended by an escort. From Noh he followed a route to the north of the mountain chain which skirts Pangong lake; and later on, after the escort had gradually dropped off, a line was struck to the west end of Pangong lake, and thence *viâ* the Kisu-la pass to Leh. After passing the Kisu-la pass the party had their worst experience of thirst. On arriving at last at water, they came into touch with civilization in the person of a hunter attached to an English lady who was shooting wild sheep in the mountains.

The primary object of the expedition was to study the natural history of the country traversed, and the collections formed *en route* will form the subject of special papers. In addition to the work entailed by the collection and preparation of specimens, observations were constantly taken to fix geographical positions along the 700 kilometres traversed in Tibet, and thermometrical and barometrical records were preserved. The story of the adventures in Tibet is extremely interesting, but it is to be regretted that the value of the book is in some degree diminished by the absence of any good map; without this it is impossible to tell where the traveller's route crossed those of Deasy, Rawling, Bower, and others who have opened up to the West this corner of Tibet. Some of the illustrations are very good, and to some extent they incidentally supply the lack of a table of contents to the chapters.'

W. R. C.

AFRICA.

The Survey of Africa.

'Colonial Reports—Annual,' No. 565. "The Surveys of British Africa, etc." London: Wyman. 1908.

'Geodetic Survey of South Africa.' Vol. 5. Reports on the Geodetic Survey of the Transvaal and Orange River Colony, executed by Colonel Sir W. G. Morris, and of its connection, by Captain H. W. Gordon, with the Geodetic Survey of Southern Rhodesia. With a preface and introduction by Sir David Gill. London: Harrison & Sons. 1908. *Maps and Illustrations.*

'Ministry of Finance, Egypt. Survey Department. A Report on the Works of the Survey Department in 1907.' By Captain H. G. Lyons. Cairo: 1908.

'Survey Department, British East Africa. Annual Report, Financial Year 1907-08.' *Illustrations.*

The existence of such a large mass of publications on the subject of the survey of British Africa and other parts of the empire is a gratifying evidence of the increasing interest taken in scientific geography and of the progress being made

in the task of mapping our possessions. While the most cursory glance at a map of the world would reveal the fact that there are still immense areas of unsurveyed country over which our flag flies, yet no one, comparing the same map as it would have appeared, say, ten years ago, could fail to see the great advance that has taken place. Not that a comparison of maps would be the best way of exhibiting this advance. The real gain of the past decade has been not so much, or perhaps not even chiefly, in the actual area surveyed, but rather in the change of spirit that has come over our administration, a change possibly dating from the time when the disastrous extravagance of bad maps was brought home to us with irresistible force in the year 1900. Unfortunately, human memories are frail, even for lessons which might be thought almost indelible, and thus we are not entitled to express surprise, however much we may be disappointed, at reading in the Annual Report of the Colonial Survey Committee the following pregnant sentence: "*No topographical maps exist of Natal or of the Transvaal, and no such maps are being produced*" (p. 30).*

It is needless for us to insist here upon the value of this little report, both as being a unique account of the progress of the year, and also, as in the case above, as containing the materials for forming a correct judgment on these points wherein lie our most manifest deficiencies. To attempt any summary of the volume would be uncalled for. To those of our readers to whom it is unknown, and to whom the survey of the empire is of interest, we can only make the recommendation that they procure a copy for themselves.

The current number, in place of dealing solely with Africa, as has been the case previously, comprises chapters on Ceylon and on the Federated Malay States, mainly in order to place on record the state of the survey of these countries as revealed by an inspection held in 1907. The total failure of the Ceylon Survey Department, in spite of vast expenditure, to achieve any maps of the island is an example of a curious phenomenon for which we can offer no rational explanation, namely, that it is apparently almost impossible for a survey not under military direction and control to produce a topographical map. It would seem that the primary function of a survey establishment, the construction of a complete and accurate map of the country, is often forgotten, and whenever we read of large areas surveyed, without any corresponding maps appearing, we may fairly conclude that this has been the case.

Those interested in geodesy and in the higher branches of scientific survey will turn with interest to the volume containing the account of the geodetic survey of the Transvaal and Orange River Colony, executed by Sir W. G. Morris and Captain Gordon, R.E., under the direction of Sir David Gill. The general scope of this work and the project of a meridional arc through Africa joining up with the European triangulation is well known, and we need not pause here to enlarge upon its importance as the fundamental basis for the mapping of the whole of South and East Africa. We may note with pleasure that the South African part of the arc is now completed, Dr. Rubin having carried the field work to a point 70 miles south of Tanganyika, whence the task of continuing it northward up to the British territory of Uganda devolves upon German experts. The high standard set by Sir W. Morris and his able staff can hardly fail to have a stimulating effect upon all first-order triangulation undertaken in the future, and we cannot doubt that the experience gained will be of substantial value when the task of reobserving the principal arcs in the United Kingdom, a duty already too long deferred, is put in hand.

* We understand that in the Transvaal this deficiency is likely to be made good at an early date.

In further connection with the African arc we may extract from the Annual Report of the Egyptian Survey Department the gratifying information that "the Geodetic Triangulation of the Nile valley has been definitely commenced." As the Uganda section has now been for some time in progress, we are able to congratulate ourselves that all parts of it lying in our own territory, with the exception of that traversing the British Sudan, are either completed or in hand.

In many other directions Captain Lyons' report contains evidence of solid progress, and we can most heartily compliment him and his staff on the state of efficiency of the whole department. We may also congratulate those in charge of the finances of Egypt that they have recognized that a wise expenditure upon services, of which the direct usefulness may appear remote, is often the most enlightened policy, and not seldom the best economy. The example is one in which, in these days of growing materialism when governments are more and more reluctant to spend money upon anything that has no immediate practical application, we might ourselves take to heart.

The Annual Report of the Survey Department of East Africa exhibits conditions very different to those obtaining in Egypt. In the first place, the country is one which does not yet pay its way, so that all expenditure is most rigorously scrutinized; and, secondly, the land is not occupied by an old-established population, with their system of landholding crystallized by centuries of usage, but is one in process of being thrown open to the white settler. The rate of influx of these settlers varies over large limits; but however quickly they may enter the country, the Survey must keep pace and give them their farms, properly marked out on the ground, and their title-deeds with correct plans of their holdings attached, with no undue delay. Up to two years ago large arrears of this work had accumulated. Now these arrears have been almost wiped off, and not the least interesting part of Major Smith's report is that describing a method of rapid allotment of farms tried experimentally over a substantial area of country.

East Africa is possibly the first place where the attempt has been made to construct a general cadastral map as the country is opened out to settlement. The wisdom of this policy cannot be proved for many years; we can only hope that it will realize expectations and justify itself as a wise and economical one.

E. H. H.

AMERICA.

Exploration of the Canadian West.

'The Search for the Western Sea.' By Laurence J. Burpee. London: Alston Rivers. 1908. *Price* 16*s. net.*

This book is in close relation with the 'Story of Exploration' series, issued by the same publisher, the only reason for its separate appearance being, apparently, its greater bulk. It forms a natural complement to the volume on the St. Lawrence Basin, by Dr. S. E. Dawson, and is equally satisfactory in its treatment of the subject. By extended study, Mr. Burpee has made the theme dealt with thoroughly his own, and has thus avoided the pitfalls which beset the path of a writer who has "got up" his subject for the occasion. While fully cognizant of the previous literature on the subject, he is not content to follow his predecessors blindly, and in not a few cases is able to correct errors into which they have fallen.

Starting where Dr. Dawson's book left off, Mr. Burpee carries the story of exploration through the regions beyond the great lakes to the shores of the Pacific. As indicated by the title, he regards the efforts of the hardy pioneers, both French and English, as directed, amid all the minor influences at work, to the definite goal of the setting sun and the distant ocean. The narrative certainly gains

in point and unity by keeping this underlying motive in the foreground, though it would be a mistake to suppose that all the actors were consciously actuated by it. The vividness of the story is likewise enhanced by the grouping of the material according to the leading characteristics of the three main episodes, the first book being concerned with the efforts put forth by the "Northern Gateway," by agents of the Hudson Bay Co., and with Hudson bay as a starting-point; the second with the French pioneer work, from a more southern starting-point, in the region beyond Lake Superior; and the third with the completion of the task by British subjects after the overthrow of French dominion. A possible objection might be that the unavoidable overlapping, both chronological and topographical, especially of the two first sections, makes it somewhat difficult to keep in view the strict sequence of events, but this hardly, perhaps, outweighs the advantages of the arrangement adopted.

Many matters of detail might be referred to, did space permit. Apart from the work of men like Hearne, Mackenzie, or La Vérendrye, much of the story has to do with names little known to the general public, though well deserving to be kept in memory. Henry Kelsey, one of the earliest pioneers to the west of Hudson bay, is the subject of a special chapter, though it is hopeless to attempt an exact reconstruction of his route. We learn much of the work of Hendry, Turner, Fidler, Pond, and others, and the relative value of their performances is carefully appraised. We miss a connected narrative of the journey of Matthew Cocking (though it is several times alluded to), and the author was unable to gain access to the journals of Pond, which have only recently been brought to light. In the third book, full justice is done to the great journeys of Mackenzie, Thompson, Henry the younger, and others, though the order in which their careers are dealt with is a little difficult to account for.

The book throws an interesting light on the policy pursued by the great fur companies, and the extent to which the results were due to the personal enterprise of the men employed. We are enabled to trace the fortunes of the various outposts, which served as halting-places or advanced bases for the more distant journeys, while the importance of the various natural gateways into the Far West, like the famous Frog and Grand Portages, is well brought out. There are numerous reproductions of early maps (not always, however, quite judiciously placed), and many excellent photographs of places and scenes. In regard to the general map, it is to be regretted that the too common practice of using one prepared with no immediate reference to the subject has been followed. Excellent in itself, it is filled with irrelevant modern details, while we look in vain for many of the early landmarks, such as Grand Portage, Kaministikwia, or Cumberland House. But this is a matter for which publisher rather than author must be held responsible.

E. H.

GENERAL.

A Varied Career.

'Dan to Beersheba.' By A. R. Colquhoun. London: Heinemann. 1908. Pp. xviii., 348. *Portrait.* *Price* 8*s.* 6*d.*

We should have been the poorer for want of Mr. Colquhoun's narrative of his own career contained in the present volume. Few have had, or made, such opportunities for travelling as he, and few have had so many and varied experiences in imperial politics. For Mr. Colquhoun, by several previous works, has shown himself an imperial politician of peculiar power and independence, and in this work we learn how he has achieved this position. India, Burma, Siam, China, French Indo-China, Burma again, South Africa, North and Central America—these are the lands where the bulk of his work abroad has been done. To geographers the

visits to Siam and China are of first interest, for it was during the mission which he accompanied to Siam that the idea originated of the journey across Southern China into Burma. There is in the present volume a succinct account of this journey, with its extraordinary hardships, which brought him a prominent position among explorers and the Gold Medal of this Society. But all through the book one is impressed with his power of impressing his own individuality upon any work he took up, and of developing some new interest out of it, whether it be his scheme for a railway from Burma through Siam and Southern China, which he actively, though vainly, pushed forward after his travels there, or what not. Apart from this particular journey, his book deals rather with men and matters than with geography in any form, but we are able to gather not a few geographical pictures here and there—the sojourn in South Africa, for example, when Mr. Colquhoun was associated with Rhodes, provides several. One cannot, in conclusion, refrain from the remark that the tone of this, the most difficult kind of book to write in such a way as to offend no reader, is wonderfully successful. The author's modesty is unstudied, and in analysing the feelings of those with whom he has come into disagreement, he tries, with admirable justice, to put himself into their position.

O. J. R. H.

EDUCATIONAL.

'Lands beyond the Channel.' By H. J. Mackinder. London: Philip. 1908. Pp. xii., 276. *Maps and Illustrations.* 1*s.* 9*d.*

'Practical Geography.' By J. F. Unstead. Oxford: Clarendon Press. 1908. Pp. 120. *Maps and Diagrams.* 1*s.* 6*d.*

'Practical Exercises in Physical Geography.' By W. M. Davis. Boston: Ginn. 1908. Pp. xii., 148. *With Atlas of* 45 *Plates.* 3*s.* 6*d.*

School "geography" is looking up. It must be, for the educational publishers of to-day were never so busy before with school geographies. To compile a list of the works which, published in 1908, are adapted to satisfactory up-to-date teaching in the schools of to-day is no mean task. These are three of the latest, two of which are eloquent of the present demand for books which shall make the boy or girl think out and work out problems of geographical import, and the third typical of the best and most suggestive kind of the now rather old-fashioned reader.

To begin with the last-named, Mr. Mackinder's 'Reader.' In using the adjective "old-fashioned" it should be understood that no deprecation is implied, for 'Lands beyond the Channel' is written up to the high-water mark of twentieth-century "Readers," and this should tell even in the case of the many schoolmasters who do not care for this type of book. It is the second volume of the author's 'Elementary Studies in Geography,' the first of which was reviewed in the *Geographical Journal* of May, 1907, p. 560. Vol. 2 deals with Europe and the Mediterranean, and, as promised, provides an advance in subject and method on its predecessor. The method is mainly historical, and therefore pre-eminently *human*. Throughout, indeed, and much more so than in "our own islands," history is to the front. Treated in this way, the connection between geography and history is one of cause and effect, and both subjects gain in consequence. The importance assigned to France is symbolical; one-third of the whole book is given to "our nearest neighbours, both, geographically and historically." In a book of this nature, it was necessary in the early chapters to correlate a variety of data in order to give a vivid conception of any foreign land. Mr. Mackinder begins with allusion to the history and character of the French people. The growth of Paris and the geographical works thereof follow. The results in the radiation of road and rail from the capital are made use of in a scamper through the country—to Normandy and Brittany, the Spanish borderland, Marseilles and the Riviera, the central tableland,

and the eastern frontier. The last-named is particularly an example of the interrelation of geography and history, and its famous "gates" are well emphasized with Sedan and Waterloo as supreme witnesses. A chapter on "Political France and its Government," and a brief comparison with the United Kingdom in point of size, distribution of population and pursuits, close the section. The rest of the book is on the same lines—cause and effect, geography and history. The pictures are illustrative, and there are plenty of them. One misses the explanations and questions which in vol. 1 added point to the sketch-maps. It should surely, also, be counted as a defect that not one single map throughout the book, large or small, painted or plain, has any indication whatever of longitude and latitude.

Mr. Mackinder taboos exercises. "A geographical text," he says in his preface, "should aim at literary form," and you cannot have literary form if it is constantly to be broken in upon by exercises. Mr. Unstead and Prof. Davis supply the exercises which nowadays should at all events supplement the teaching of the text-book. These two books contain exercises and nothing but exercises. They eschew literary form. The *magnum opus* of the great Colenso of famous memory in another branch of knowledge may be compared for literary form with latter-day treatises on "Practical Geography." But both these talented compilers lay stress on the fact that exercises are only one part of geographical work in school, and that all such practice must be correlated with descriptive work, whether oral or text. The need of exercises is universally admitted, and indeed enjoined, by such arbiters of scholasticism as Boards of Education, Boards of Studies, *et hoc genus omne*. The worst failing of the modern teacher is that he will do too much of the work of the class himself, and will not insist on his charges thinking out and working out problems which will lead up to geographical facts. These two books of exercises give him his opportunity. Prof. Davis puts it well: "The careful performance of the exercises will lead the pupil to observe, to describe, and to generalize; to make inferences, to invent explanations, and to test theories; to express new ideas verbally and graphically. If the teacher is patient and *does not infringe too often on the pupil's right of discovery*, the pupil may make so much progress in these various processes, and at the same time acquire so good a knowledge of a great group of natural phenomena, that he will really be led to make a beginning in the formation of scientific habits of thought."

Mr. Unstead's 'Practical Geography' belongs to the series of 'Oxford Geographies,' now being edited by Dr. Herbertson. It contains a large number of exercises—412 in all—designed to test and practise pupils in causes and effects, and to accustom them to use statistics in suggestive and intelligent fashion. Figures are supplied for the purpose—figures of rainfall and temperature, of population, of agriculture, mining, and commerce. The book is set out in four sections: Maps and plans, the home district, the weather, the British Isles. Most of the exercises are unimpeachable, but some appear to challenge criticism. "Collect specimens of the following rocks, whether they form part of the ground of your district or not, and also specimens of any others you can yourself find: granite, slate, marble, limestone, chalk, shale, clay, sand, gravel, sandstone," reminds one of question 1 in an erstwhile famous classical examination paper: "Write out the Latin grammar"! But the book is good if used rightly. A too slavish adherence to it would take much of the human interest out of geography—a remark which applies even more emphatically to the scholarly work of Prof. Davis. His exercises, again, are legion, and very few of them of "human" interest. There is much of the mountain as a base for measuring elevation and determining the temperature at different levels, and very little of the mountain as affecting the life and condition of the surrounding peoples. The professor designedly leaves such humanistic questions

to the teacher, who will probably omit them for want of time. As it is, he implies the time difficulty and places many of his enormous collection of exercises between brackets, thereby signifying that these may be omitted if necessary. Interest, too, tends to flag a little with page after page of this type of exercise: "What is the altitude of river Y 4 miles from its mouth? At what distance from its mouth is the altitude of river Y 160'? What is the altitude of the N.E. branch of river V at 14 miles from its mouth? In 24 the baseline represents sea-level; the spaces between the vertical lines represent distances of 2 miles: how are altitudes indicated?" and so on—some of a set which the author specially draws attention to as being particularly stimulating. However, one can always select, and the wise teacher will do so. Incidentally, he himself will learn much, for the examples are naturally mostly American, and many terms as yet unknown to English school text-books will arrest his attention. "Accordant" and "discordant junctions," "elbow of capture," "misfit stream," "interfluve," "monadnock," are some of them. The maps and plans in the atlas are good and very suggestive, though the continental maps at the end of the book seem unnecessary.

E. R. W.

History of the Mongols.

'The Mongols: a History.' By Jeremiah Curtin. With a Foreword by Theodore Roosevelt. Pp. xxvi. + 426. London: Sampson Low. 1908. 12*s.* 6*d. net.*

This is a posthumous work introduced with a flourishing "foreword" by President Roosevelt, who took a personal interest in the writer and perhaps rated him somewhat too highly. At least, it seems excessive eulogy to assert, in the face of Sir H. H. Howorth's encyclopedic 'History of the Mongols,' that "in this particular field no other American or English scholar has ever approached him." Although his name is little known in England, Mr. Curtin was certainly a diligent writer with a remarkable knowledge of languages, which enabled him to deal with a great variety of subjects—such as Irish and Slav folklore, native American mythologies, and his better-known translations of Sienkiewicz's Polish novels. But this last product of his versatile pen can only be described as a modest compilation from generally accessible sources, without any pretensions to original research, and mainly restricted to the historical period from the rise of Genghis Khan to the absorption of the Mongol peoples in the Chinese and Russian empires.

It is a well-executed manual, brightly written, and mostly free from errors of detail. Being, moreover, furnished with a carefully prepared map of the Mongol empires in the thirteenth and fourteenth centuries, and with a fairly copious subject-index, it will be found a convenient book of reference for students not needing to consult larger and more exhaustive works. But it suffers considerably from the lack of final revision by the author. Thus the Meru (Merv) of Turkestan is spoken of as "renowned in Sanskrit poems," being thus confused with the Meru of Hindu writers. Then we have "Cairo in Europe," Nanking on the Hoang-ho, though rightly placed on the map; Michael Palaelogus; Humboldt's mythical "Bolor" range, and a few awkward expressions—such as "all Turk nations"; "he was a man of more courage than art thou"; Khovarezm for Khwarezm, and some other misprints.

A. H. K.

SHORT NOTICES.

Europe.—'Mountaineering in the Land of the Midnight Sun.' By Mrs. Aubrey Le Blond. (London: Fisher Unwin. 1908. Pp. xi., 304. *Map and Illustrations.* 10*s.* 6*d.*) This is a delightful volume which should appeal to a wide circle of lovers of Norway, not only to mountaineers. Mrs. Le Blond was climbing not far from

Tromsö, where she had ample opportunity for "first ascents." Her photographs are unusually good.

'Bird Hunting through Wild Europe.' By R. B. Lodge. (London: Culley. 1908. Pp. 333. *Illustrations.* 7*s.* 6*d.*) Bird-photography has some of the requisite attributes of a sport; it may lead its pursuer into positions of difficulty and even danger, and it calls for unwearying patience. This book will therefore interest many. It deals with three expeditions—in Spain, and in Bosnia, Montenegro, Albania, and Rumania. It is not at all technical, though the touch of the practised ornithologist is evident; it describes, simply, the author's adventures, failures, and well-deserved successes. Geographers will gather numerous intimate topographical notes from Mr. Lodge's close observations.

'The Bridle Roads of Spain, or Las Alforjas.' By George John Cayley. (London: Fisher Unwin. 1908. Pp. 397. *Illustrations.* 7*s.* 6*d.*) This is a justifiable reprint of a book which first appeared in 1853. It is justifiable not only because of the author's striking personality (which is brought out in the preparatory recollections by Lady Ritchie and Mrs. Cobden Sickert), but because it gives so intimate a picture of the byeways of Spain in the middle of the last century. The journey was full of adventure and far from free of danger; and apart from this, the narrative is so brisk and vivid as to prove at once its fascination and its value. The reprint as a whole is well done, but there are certain errors in foreign languages.

'Highways and Byways in Surrey.' By Eric Parker, with illustrations by Hugh Thomson. (London: Macmillan. 1908. Pp. xix., 452. *Map.* 6*s.*) This volume certainly has nothing in it to lower the standard of a well-known series. Many of Mr. Thomson's illustrations are as charming as any in other volumes. The text bears constant evidence of Mr. Parker's intimate topographical knowledge, even though one may think that he might have made more of some of the best-known features of the county—Hindhead, for example.

'The East End of Europe.' By Allen Upward. (London: Murray. 1908. Pp. xxiii., 363. *Maps and Illustrations.* 12*s.*) This book is the result of a recent "unofficial mission" in European Turkey. It is a close inquiry into the racial questions which are agitating that country. From a geographical point of view, the most interesting feature of the book is the map, which shows the remarkably wide distribution of Greek schools throughout Macedonia, together with other Christian schools—Bulgarian, Servian, and Rumanian. It is the compilation of a member of the Greek Foreign Office, and Mr. Upward vouches for its accuracy so far as he was able to check it.

'Greece. Handbook for Travellers.' (Leipzig: Baedeker; London: Dulau. 1909. Pp. cxxvi., 447. *Maps.* 8*s.*) As regards the fourth edition of this well-known guide, it is only necessary to say that the revision appears to have been mainly in the direction of archæology, the results of recent research being embodied. But in other respects the whole work bears evidence of very careful editing.

'The Levantine Riviera.' By W. T. Beeby and E. Reynolds-Ball. (London: Reynolds-Ball's Guides. 1908. Pp. viii., 212, 10. *Map and Illustrations.* 2*s.* 6*d.*) There is quite sufficient information contained in this guide to inform intending visitors to the Levantine Riviera and to assist them when they carry out their visit. It is contained, however, in a conveniently small compass, and the book is more attractively printed and produced than the majority of really useful guides.

'Through Corsica with a Paint-brush.' By Mrs. E. R. Whitwell. (Durham: W. Dresser; London: Simpkin Marshall. 1908. Pp. 67. *Map and Illustrations.* 6*s.* *net.*) Corsica appears to have attracted attention from several literary visitors lately. It cannot be said that the text of the present volume adds much to previous knowledge of the island. But the three-colour illustrations from the writer's pictures

are quite among the best we have met with, reproducing work which must be admirable in the original without the common faults of the process.

Asia.—'The Commercial Products of India.' By Sir George Watt. (London: Murray. 1908. Pp. viii., 1189. 16*s.*) This is a corrected and abridged edition of the same author's 'Dictionary of the Economic Products of India (1885–94),' now out of print. It is of encyclopædia form, consisting, that is, of articles on each product of present or prospective commercial value, arranged in alphabetical order. It is indexed also, so that it forms a perfect work of reference. The articles have a marginal analysis, and contain copious references to authorities, besides being themselves authoritative. The book is published under the authority of the Secretary of State for India, and when it is considered that the same remark applies to the newly issued 'Imperial Gazetteer of India,' it must be admitted that India could hardly be better supplied with works of reference.

'By Desert Ways to Baghdad.' By Louisa Jebb (Mrs. R. Wilkins). (London: Fisher Unwin. 1908. Pp. 318. *Map and Illustrations.* 10*s.* 6*d.*) The authoress of this work and a companion, travelling from Konia, proceeded by Adana and Birejik to Diarbekr, and down the Tigris to Baghdad, visited Hillah and Kerbela, and then west up the Euphrates to Deir, and thence to Damascus. This is one of those journeys which gains interest from the fact of its difficulties having been overcome by ladies; and though the narrative is mainly one of personal experiences, and can hardly be expected to provide any new scientific facts, it is so entertaining that it may be read with profit; and it is well illustrated.

'The Far East Revisited.' By A. Gorton Angier. (London: Witherby. 1908. Pp. xii., 364. *Maps and Illustrations.* 10*s.* 6*d.*) This is an excellent contribution to the political and economic geography of the East. The author, as editor of the *London and China Express*, has distinctly the qualifications of authority. He covers an extensive field—British and Dutch Malaya, Siam, Hong Kong, China, Korea, and Japan. The book is not intended to provide an exhaustive study of any of these divisions, but it is remarkably full of varied information considering its wide scope.

'Kashmir, the Land of Streams and Solitudes.' By P. Pirie. (London: Lane. 1909. Pp. 269. *Illustrations.* 21*s.*) Perhaps the title of this book is a sufficient indication of its textual contents, which are admittedly slight in character. The more important feature of the volume is the illustrations, by H. R. Pirie. Those in colour, which are loosely mounted on a dark background, are very good examples of the three-colour process. The studies in which snow-mountains occur are especially praiseworthy. The black-and-white drawings, if less successful, are still full of character.

'La Perse d'aujourdhui.' By Eugène Aubin. (Paris: Armand Colin. 1908. Pp. viii., 442. *Map.* 5 *fr.*) This book presents a view of Persia, taken at the time of the first incidents of the present upheaval in that country, from the political, economic, and social points of view. The narrative of the author's own journeys, which were confined to the west and north-west of the country, contain many observations of value. The methods of the French publisher are not as ours, but this volume appears to be a particularly poor example of their work.

'Hindustan: Indische Reiseeindrücke.' By Ernst Hengstenberg. (Berlin: Reimer. 1908. Pp. xii., 191. *Illustrations.* 8*m.*) This volume contains the impressions of an extended journey in India. The author visited Bombay, Jaipur, Delhi, Simla, Agra, Benares, Darjeeling, and finally Ceylon. The opportunity is not often open to English readers to obtain the views of a foreign traveller in India so well equipped as an author. The reproductions from photographs scarcely reach the standard of those in similar works produced in this country.

Africa.—'Guide to South Africa.' Edited by A. Samler Brown and G. Gordon Brown. (London: Sampson Low. 1908. Pp. xlii., 478, 54. 2*s.* 6*d.*) This excellent guide, produced in annual editions (the present is the sixteenth) for the Union Castle Steamship Company, maintains its reputation. The tourist, sportsman, invalid, and intending settler are all catered for, and a large amount of new information has been added in each department. The full index also gives the book the value of a gazetteer. Among the maps (several of which are also new) there are not only those for ordinary topography, but also orographical, meteorological, or other maps of special purpose.

'My African Journey.' By the Rt. Hon. Winston Spencer Churchill. (London: Hodder & Stoughton. 1908. Pp. xiii., 226. *Maps and Illustrations.* 5*s.*) Many have already made acquaintance with Mr. Churchill's notes of his journey from Mombasa to Alexandria in serial form, and may be glad to preserve them in this (considered as a publisher's production) somewhat commonplace volume. With his unique opportunities, Mr. Churchill has, of course, much of interest to tell of what he saw and thought of the country and its resources. But he should not be followed too far into the domain of science or of history. Against this his imaginary narrative of Speke's discovery of the source of the Nile is a sufficient warning.

'On Safari.' By Abel Chapman. (London: Arnold. 1908. Pp. xvi., 340. *Maps and Illustrations.* 16*s.*) This is a study of the fauna, and especially of the big game, of British East Africa. The author proves it by his own experience to be "probably the most glorious hunting-field extant, certainly the most accessible," and his book, with Mr. E. Caldwell's illustrations from the author's sketches on the spot, adds much to our knowledge of it in this department. An appendix contains what is offered as "rough veld-notes" on the bird-life of the country. Apart from its scientific value, the many readers who enjoy good hunting stories should welcome this volume.

'Some African Highways.' By Caroline Kirkland. (London: Duckworth. 1908. Pp. xvi., 345 [?335]. *Map and Illustrations.* 6*s.*) This book narrates "a journey of two American women to Uganda and the Transvaal." It is pleasantly written and interesting, though not offered as anything more than a description of "one of the most fascinating tours in the world." It is illustrated with good photographs, though the map is singularly bad.

'Im Auto zu Kaiser Menelik.' By Arnold Holtz. (Berlin: "Vita" Deutsches Verlagshaus. 1908. Pp. 92. *Illustrations.* 3*m.* 50*pf.*) This is a short account of a journey made across Abyssinia by motor-car to Menelik's capital. It was an adventurous journey, which attracted considerable attention at the time it was made, and resulted in a favourable reception of the travellers, and in concessions being made to them. The varying character of the country traversed is described in considerable detail, and the illustrations help the description.

America.—'Canada et Canadiens.' By A. Loir. (Paris: Guilmoto. 1909. Pp. 371. 6 *fr.*) This book is not so much a narrative of the author's travels as a collection of essays on various familiar Canadian topics. For example, Dr. Loir gives an early place to "souvenirs" of the French in Canada. We have also such diverse subjects as the birth-rate and medical questions, the Indians, the Mormans and Doukhobors, the Japanese and Jews, education, agriculture, etc.

'Camp Fires on Desert and Lava.' By W. T. Hornaday. (London: Laurie. 1908. Pp. xx., 366. *Maps and Illustrations.* 16*s.*) This is an account of explorations in the deserts on either side of the American-Mexican frontier, the Sonoran and Pinacate regions. It is not a scientific account, but rather a colloquial narrative. But the travellers visited country practically or even entirely unknown, which, if the natural obstacle of aridity can be artificially overcome, as is believed,

may some day be turned to profitable use. There are some particularly good coloured illustrations, besides half-tones.

General.—'Recollections of a Life in the British Army.' By General Sir Richard Harrison. (London: Smith Elder. 1908. Pp. viii., 382. *Illustrations.* 10*s.* 6*d. net.*) This record of the author's career is simply told, but full of interest. His foreign service took him to India, China, and South Africa; and during the latest war in the country last named he was employed in a high position at home. In an appendix is printed a report made to the author by the Prince Imperial in Zululand.

"Romance of Empire" Series. (London: Jack. 1908. 6*s. net each.*) 'Outposts of Empire.' By John Lang. (Pp. xii., 287.) 'New Zealand.' By Reginald Horsley. (Pp. xiii., 331.) These volumes (the first of which deals with Gibraltar, Malta, and the West Indies) certainly do not fall short in their design to stimulate interest in the making of the Empire. Complete histories they are not, nor pretend to be. And as it must be impossible to please all tastes in the selection of incidents for treatment, they should, perhaps, be read uncritically. Many of the coloured illustrations are exceedingly effective.

'Our Empire Story.' By H. E. Marshall. (London: Jack. 1908. Pp. xiv., 493. *Maps and Illustrations.* 7*s.* 6*d.*) This is another book of style and character similar to those noticed above, and from the same house. It is addressed, however, to children, and to them its simple and vivid diction should be most attractive. It deals in successive parts with Canada, Australia, New Zealand, South Africa, and India. It has coloured illustrations, like those in "Our Empire" series, imaginative and effective, and some simple sketch-maps. It would be better if congruity of fact could be established between these volumes. For example, in the 'New Zealand' noticed above we read that "what became of Te Kooti [the insurgent] no one seems to know. He simply disappeared . . . Some say that he . . . hid himself in the King country; others aver that he was slain there by the Waikoto, . . ." and so on. In the present volume we are told that Te Kooti, after his escape, "gave himself up, was pardoned, and henceforth lived in peace."

THE MONTHLY RECORD.

EUROPE.

The Climate of the Orkneys is discussed by Mr. M. Spence in the *Journal* of the Scottish Meteorological Society, vol. **14**, No. 25. After pointing out that the climate is so much modified by the currents and moisture-laden winds of the Atlantic as to be unrecognizable by its latitude, while its vagaries defy the systematic classifications of the meteorologist, the writer refers to the question of a possible modification of the climate in recent times. The early accounts consist chiefly of vague generalizations, but a statement by a Mr. Mackaile that a fortnight of frost and snow in 1665 was an occurrence unheard of by any then living, seems certainly to indicate that oscillations have occurred. That they took place in very early times is shown by the remains of dwarf forests intercalated in the peat bogs, while the treeless nature of the group at the present day (easily explained by the great frequency of gales) is well known. Of the plants of the present day, several seem to be on the verge of extinction, and though casual introductions from more northern regions seem to quickly gain a footing, those from further south soon die out. The opinions of old inhabitants that the winters were formerly much colder may need to be received with caution, but the available statistics, going back some eighty years, seem to prove that the yearly range of temperature has become less

within recent times. The extremes are naturally less than on the east coast of Scotland generally, while the rainfall is slightly higher. The growth of vegetation is often greatly retarded in spring, though after midsummer day rapid progress takes place. Contrary to the current belief, south and south-east winds are much more frequent than those from the south-west and west.

Zones of Vegetation in the Balkan Peninsula.—This subject has been dealt with by Prof. L. Adamović, whose previous contributions to our knowledge of plant distribution in Eastern Europe are well known (see, *e.g.*, *Journal*, vol. **29**, p. 85), in No. 9 of *Petermanns Mitteilungen* for 1908. Out of the thirty-odd systems which have been used for classifying the altitudinal zones of vegetation, Prof. Adamović selects the following as best fitting the case of the Balkans: 1. Lowlands, 0 to 300 feet, including the sandy steppes of the Danube and the bottoms of the larger valleys, covered with marshes, meadows, and natural pastures. Agriculture: hemp, beetroot, and vegetables. 2. Hill country, 300 to 1800 feet: prevalence of mixed deciduous woods other than oak, and chiefly *Fraxinus ornus*, etc. Agriculture of a northern Mediterranean type. 3. Sub-montane, 1800 to 3600 feet; mainly forests of oaks and Austrian pine. Agriculture: maize, wheat, tobacco, apple, and plum. 4. Montane, 3600 to 4800 feet; tall forests of beech and fir, mountain pastures; barley, rye, potatoes; limit of crops. 5. Pre-Alpine, 4800 to 5700 feet: forests of beech, spruce, Scots and other pines; pastures. 6. Sub-Alpine, 5700 to 6900 feet; prevalence of bush and shrubs, and high pastures; timber-line at 6000 feet. 7. Alpine, 6900 to 8100 feet; scattered shrubs, mostly cushion-shaped; meadows and pastures. 8. Sub-nival, 8100 feet to summits; scattered, carpet-shaped under-shrubs; thin Alpine swards.

Geography in Hungary.—The following particulars are taken from the Report of the President of the Hungarian Geographical Society for the year 1907. Dr. Lóránd Eötvös had carried out investigations of the gradients and levels of gravitational force in the Southern Alföld (between the Danube and the Theiss), the results being recorded in the *Verhandlungen* of the Association Géodésique Internationale. The publications of the Balaton Lake Commission were on the eve of conclusion, though this had been delayed, first by the comprehensive character of the material, and further, by the discoveries due to the new Balaton Lake railway along its north-western shore. The following works dealing with the results of scientific exploration of the lake appeared in 1907: 'Die Eisverhältnisse des Balaton,' by Dr. Jenö Cholnoky; 'Die tropischen Seerosen im Kerzthélyer Warmbade (Hévéz),' by Dr. Sándor Lóvassy; and lastly, 'Die Kirchen und Burgen der Umgebung des Balaton in Mittelalter,' by Dr. Remig Békefi. The palæontoiogical volume was in process of publication, geological land-surveys were in active progress; but systematic geological investigations of the great mountains of the land were not yet forthcoming. As regards hydrography, climate, faunal and flora distribution there is much to be done, for though many data exist, these have not yet been worked up in a generalized form. Part of the blame may be imputed to the rigorous adherence to German and Austrian models, for in its geographical conformation Hungary is in great measure unique, or at least more closely allied with Rumania, South Russia, and even Western Asia than with the lands bordering it on the west. Some of the best recent geographical work on Hungary has been done by foreigners, excellent examples being De Martonne's study of Southern Carpathians, Cvijić's memoir on the Iron Gate, Uhlig's on the tectonics of the Carpathians, and that of Pax on the geography of the Hungarian flora. On the other hand, it is only necessary to mention the names of Déchy, Dr. M. A. Stein, and Angelo Heilprin to show that Hungarians have done good geographical work outside their own land.

ASIA.

The Climate of Ancient Palestine.—The important question whether the climate of Palestine has changed for the worse within historic times, as has been supposed by some writers, is ably discussed by Prof. Ellsworth Huntington in the *Bulletin of the American Geographical Society*, Nos. 9–11, 1908. The idea of such a change has been suggested by the present poverty-stricken condition of the country, which seems to offer a marked contrast to the state of things deducible from the biblical narratives. But while admitting that such a decay has taken place, this has been ascribed by others (especially among recent writers) merely to human folly and misgovernment. Prof. Huntington points out that even at the present day, the central plateau enjoys a moderately favourable climate, so that it is to the outlying regions, where an increase of, say, 30 per cent. in the rainfall would make a far greater change in the conditions of human life, that the chief evidence of change is to be expected. He also insists on the delusive nature of arguments which depend on the human factor, and the desirability of appealing to kinds of evidence where the part played by man can be estimated with a fair degree of accuracy. After briefly discussing the theories of previous writers—which he describes as the hypotheses, respectively, of uniformity; of deforestation as the agency of change; and of progressive change from the conditions of the glacial period to those of the present day—he attempts to harmonize the first and third of these by supposing a series of pulsatory changes, which, while consistent with a belief that conditions like those of to-day existed one or two thousand years ago, would also admit the supposition that a greater rainfall or lower temperature has prevailed in the past than in the present. The changes demanded are not necessarily of a very radical nature, and a change of from 3° to 5° Fahr. in the mean annual temperature would, it is held (with the corresponding changes in precipitation and evaporation), have a marked effect upon the habitability of the country. The chief disadvantage to-day is not so much actual lack of rain, as the fact that practically all comes in the colder half of the year. A slight lengthening of the rainy season would be of very great value, and a lower winter temperature, by increasing the amount of snow, might favour the saturation of the ground at this season. Among the various lines of evidence which have been supposed to point to a change of climate, Prof. Huntington relies less on the supposed decline of population or destruction of forests, than on the facts connected with ancient routes of invasion, migration, and trade, and with the distribution, location, and water-supply of ancient ruins. The change of climate which seems necessitated by all these facts might have been either progressive or pulsatory (the rapid fall of Palmyra and its later rise in the middle ages suggesting, however, a time of peculiar aridity between the fifth and seventh centuries A.D.), and it is chiefly by a consideration of the probable vicissitudes of neighbouring regions that Prof. Huntington is led to pronounce in favour of pulsatory changes.

Mr. Carruthers' Expedition to Northern Central Arabia.—Mr. D. Carruthers, who is known as an enthusiastic zoological collector, and who took part in the British Museum expedition to Ruwenzori, under Mr. R. B. Woosnam, in 1906, wrote from Beirut early in the year to say that, having met with a particularly favourable chance of entering Central Arabia from the north, he was about to start immediately. From Ma'an (south of Damascus) he proposed to go, with three camels and a few men, first to the Jauf, and then, crossing the Nefud in a new direction, to make his way *viâ* Heima to Hail. It would depend on circumstances whether he went further than Hail, and should this be his furthest point, he does not expect the journey to take more than two or three months. Mr. Carruthers'

primary object is zoology, and he hopes to obtain a specimen of the rare Arabian oryx, but he will seize any chance that may offer of furthering geographical knowledge.

Conclusion of the D'Ollone Expedition.—From a communication by Commander d'Ollone to the Paris Geographical Society (*La Géographie*, January 15, 1909, p. 55), we learn that the various members of this expedition reached Peking in safety during last autumn, thus bringing to a successful close an expedition which has been fruitful in archæological and geographical results respecting some of the least-known interior districts of China. From Lan-chou (cf. *Journal*, January, p. 89) the explorers went to Leang-chou, near the Great Wall, where they met the members of the Pelliot Archæological Expedition to Central Asia. The route had lain through an area devastated during the Mussulman insurrection, but now in process of settlement from various parts of China. Starting east from Leang-chou they reached the Hwang-ho once more, the leader then parting company with MM. Fleurelle, de Boyve, and Lepage, who reached Peking by the most direct route. Commander d'Ollone himself continued his archæological work on the southern borders of Mongolia, visiting the capital of Alashan, and afterwards carrying out excavations near the Catholic Mission of San-tao-ho, on the Hwang-ho. The objects collected will, he hopes, permit a determination of the period when this sandy desert was a well-peopled and fertile region—probably about the time of the Han dynasty. He then descended the Hwang-ho in a boat to Ho-kou (like M. Bonin, he remarks on the extent to which the river is navigated), and visited the Buddhist grottos of Tatong-fu, afterwards meeting the Dalai Lama at Wu-tai-shan (the famous place of pilgrimage), and reaching Peking on September 27. MM. de Fleurelle and de Boyve had already sailed for France, where they were to work up the material for the map.

Dr. Legendre's Explorations in Western Sechuan.—This traveller, whose explorations have already been referred to in the *Journal*, has communicated to the Paris Geographical Society an account of his explorations of the Wa-pao-shan, a mountain group lying between the Ya and Tung rivers, and east of the high-road from Ya-chou to Fulin. The area enclosed within these bounding lines is not large, but as it lies off the beaten track it has hitherto been imperfectly known, and its features are shown in a generalized way only in Mr. Fergusson's map issued with the *Journal* for December last. During the last two summers Dr. Legendre traversed the massif three times, crossing the water-parting on one occasion at an altitude of about 10,400 feet, while a higher range to the south reached a height of 11,500. He speaks enthusiastically of the primeval forests which clothe the mountains, which harbour a varied fauna, and might be exploited with advantage, though the Chinese who are scattered in small numbers over the district pass a most wretched existence. The traveller made a compass survey of his routes, besides taking observations of altitude and angle of slope, and collecting geological and botanical specimens.

AFRICA.

Meroe.—The Khartum correspondent of the *Times* telegraphed on January 20 that an important city site had been discovered by Prof. A. H. Sayce about 3 miles from Kabushia, where rise the well-known Meroitic pyramids. Prof. Sayce seems to have found remains of a great wall and of a temple with an avenue of rams, which he believes to be that mentioned by Strabo as existent at the southern Meroe. If so, then this site is that of Meroe itself, to which the pyramids belonged. A statue of a king and some small objects are also reported to have been found. It has long been an accepted belief that Meroe was near Kabushia, and not at Naga,

whose group of temples led Cailliaud to the erroneous view that the city was there. The modern representative of the old capital is Shendi. The pyramids have been more than once searched, and a remarkable collection of jewellery, from a find made there, is in Berlin. A few years ago Dr. Wallis Budge resumed the search, but with small success. A re-excavation of the grave-field, combined with an exploration of Prof. Sayce's site, would probably lead to very interesting results.

Earth-movements round the Victoria Nyanza.—When discussing, in an appendix to Sir W. Garstin's 'Report on the Basin of the Upper Nile' (1904), the variations of the level of the Victoria lake, Captain Lyons ascribed to Earth-movements certain discrepancies observable between the readings at the several lake-gauges. He has since pursued the matter further, and, in a paper printed in the *Cairo Scientific Journal* for November, 1908, he summarizes the evidence pointing to the occurrence of such movements both before and since the date of the above-mentioned report. Captain Lyons states concisely the history of the various gauges, and points out the discrepancies which remain when the corrections rendered necessary by changes in the gauges have been made. From the anomalies presented by the Entebbe records between 1897 and 1901, it appears that on the whole there must have been a differential downward movement of the land there in 1898 and 1899, and that a further sinking took place in 1901. In 1902 and 1903 there were months in which the parallelism between the Kisumu and Jinja (Ripon falls) gauges was not maintained, pointing to a probable movement at the latter locality. Early in 1908 the records at Entebbe and Jinja again showed marked differences, leading one to suppose that the phenomena which occurred between 1898 and 1901 have been recently repeated. Captain Lyons sketches our knowledge of the tectonic relations of the area around the lake, showing how probable it is that frequent and recent differential movements of great blocks of country have taken place, as is indicated by the numerous lines of faulting. Lake Victoria itself seems to be outlined by such fractures, and the proximity of the watershed to the northern shore suggests the upheaval of a block along an approximately east-and-west axis, with the formation of the lake as a result. The evidence of the lake-gauges is of special value owing to the fewness of the cases where such movements are taking place so rapidly, and where there is a ready means of measuring them.

The Hassert-Thorbecke Expedition to the Kamerun.—A last instalment of the reports on this expedition (*Journal*, vol. **32**, pp. 184, 530), which was brought to a successful conclusion at the end of last summer, has been printed in the *Mitteilungen aus den Deutschen Schutzgebieten* (1908, No. 4). It is mainly taken up with a description of the itinerary through the districts north and east of Bamenda. As in the districts previously visited, the country here continues to show the succession of plateaus and step-like escarpments so characteristic of this colony, the geological formation consisting generally of a foundation of granite overlain in places by extensive sheets of basalt, while laterite forms the surface layer in some parts. Many traces of recent volcanic action were also seen, including cones and crater-like depressions, the latter in several cases occupied by lakes, some of which were carefully sounded. One of the most interesting is the greater Ndu lake (so called in distinction from the lesser Ndu lake, lately discovered by the lamented Captain Glauning, by whose name Prof. Hassert proposes to call it). Even when using all his line (686 feet) Prof. Hassert failed to find bottom, and the lake is the deepest of those sounded by him. It occupies part of a hollow in the granite, in which a deeper portion (a "Maar" in German phraseology) has been blown out by explosive force. Another interesting crater-lake is that of Mauwe, which was also sounded. It lies at an elevation of 7700 feet, and a night temperature of 51°·6 Fahr. was experienced in its neighbourhood, which is densely wooded.

A characteristic feature in parts was the succession of basin-like depressions, connected by narrow valleys, the basins being of importance as sites for native settlements. A good part of the route to Banjo (the furthest point reached towards the north-east) lay in the vicinity of a great fault-scarp, by which the higher plateau to the north falls to the wide area of depression (itself, however, belonging to the plateau-region of the northern Kamerun) drained by the Mbam, which important stream was crossed and recrossed during the return march by a more southerly route. Banjo forms a sultanate of Adamaua, and its life and activity presented a marked contrast with the settlements in the forest region. A good part of the return journey to Bamenda was over monotonous grass-land, in which the only trees were in the neighbourhood of the villages, though some forest was seen. From the important town of Fumban, capital of the Bamum state, Dr. Hassert made an excursion to the recent volcanic massif of Bapit, which has a distinct crater occupied by a lake.

Dr. Chevalier's New Expedition in West Africa.—Dr. Chevalier, who since the conclusion of his great expedition to the upper Shari basin, has been engaged in researches in the French colonies on the Guinea Coast, has once more started on a new expedition to West Africa. Writing to us from on board ship on December 4 last, he stated that he expected to arrive at Konakri the following day, and that his proposed route would take him to the sources of the Niger, through the basin of the Cavalla and the southern parts of the French Sudan to Dahomé. Dr. Chevalier's former excellent work leads us to expect valuable results from this mission.

The Natural Regions of Africa.—All who have had to deal with Africa, whether from an educational point of view or in regard merely to the classification of data, must have felt the need of a broad subdivision of the surface into more or less homogeneous regions, a subdivision rendered all the more desirable (and difficult at the same time) by reason of the compact outline of the continent and the arbitrary nature of most of the political lines of partition. Such an attempt has been made in some of the text-books or general treatises, especially by Dr. Hahn in the volume on Africa in Sievers' well-known series. But in almost all cases it has been necessary for practical purposes to admit political as well as strictly geographical considerations, the result being more or less of a compromise. The most systematic attempt yet made to define a series of natural regions for the continent is that of Dr. Passarge, in Nos. 7 and 8 of *Petermanns Mitteilungen* for last year—an attempt for which the writer's wide personal knowledge of different African regions renders him particularly qualified. The method adopted is as follows: The natural subdivision of the continent in regard to the separate criteria of geology, orography and morphology, climate, vegetation, and so forth, is first considered, and the "geographical" regions are then worked out by a skilful choice of the lines of subdivision which have shown themselves of most general application. As regards geology, Dr. Passarge finds that though Suess's grouping needs modification in detail, his broad subdivision into the Atlas, the Desert Platform, and South Africa, still remains the best. Orographically there are likewise three broad subdivisions, which Dr. Passarge would label as High Africa, Low Africa, and Africa Minor, the last corresponding to the Atlas. The contrast between the higher and lower sections is more or less of a commonplace with geographers, but the line of division (which has, of course, nothing in common with the main geological boundary) may be differently drawn by different authorities. Dr. Passarge prefers to include the Congo basin, with its bounding highlands, under the heading "Low Africa," though he recognizes that the line by which this is separated from the higher region to the south and east is a more or less arbitrary one. Both High and Low Africa are in turn divided and subdivided, largely on the

basis of morphological characters. Thus the rift-valley system of East Africa differentiates it from the North-East African and the South African divisions. The subdivision into river-systems is found to have little value for the purpose in view, though that into the three hydrographical categories of permanent and periodic streams and dry watercourses is of more importance. Climatically, we obtain an important dividing line between the Sahara and the more rainy regions to the south, which has not found expression in the former systems of division. The plant formations, modes of weathering and soil formation, and faunal realms, show a close connection with the orographical and climatic regions. Coming finally to the "geographical" grouping, Dr. Passarge takes the orographical features as a basis, allowing weight to geological differences only when they coincide with those of surface form. The three main orographical divisions are retained, climatic and other factors being used as helps in the further subdivision. Thus in the case of Low Africa, we obtain, in addition to the Congo basin, three other units of equal rank, viz. the Sahara, the Sudan, and the humid and forest-clad belt of Upper Guinea. In his second paper, Dr. Passarge discusses the human geography of the continent, tracing its relation to the natural framework on which it depends. This is perhaps the most instructive part of the study, and is in fact the main justification for the labour bestowed on defining the "natural" regions.

AMERICA.

Topographical Surveys in Canada.—The Annual Report for 1806–7 of the Canadian Topographical Surveys branch was issued during 1908. Much of its contents has to do with township and other detailed surveys of a non-geographical character, but the work of some of the exploration survey parties is of more interest from this point of view. Three or four special reports deal with the country along and on either side of the line of the Canadian Northern Railway to Hudson bay, which was examined, in different sections, by Messrs. Stewart, Moodie, McLaggan, and Thibaudeau, with a view to obtaining a knowledge of its general character, soil, agricultural and timber resources, minerals, and climate, on which points a good deal of interesting information is to be gleaned, from both the reports and maps of the surveyors. South of the Saskatchewan (which the line crosses at The Pas), the most valuable timber seems to be found on the north-west side of the railway line along the eastern side of the Pasquia hills. On the south-east side a large part of the country is composed entirely of muskeg, with spruce and tamarack scrub, and in the northern section the survey party was compelled for days together to wade in water to the knees. North of the Saskatchewan, the country as far as Paint lake is reported on by Mr. McLaggan. Much of it has been swept by fire, though a growth of young timber has since come up. The numerous lakes and rivers supply a ready means of communication by canoe, and game and fish are everywhere abundant. The summer is good, and there is land suitable for agriculture, while indications of gold, silver, iron, and limestone were seen. Beyond Reed lake, Mr. McLaggan suggested as the best route for the railway a line keeping to the north-west side of the Grass river to Paint lake. Mr. Thibaudeau reports on the northern section, extending to Fort Churchill on Hudson bay, about one-third of which is marsh. The spruce and tamarack of the higher lands are suitable only for fuel and pulpwood, while no minerals are to be seen. Whitefish abound in all the rivers, and moose and cariboo occur in fair numbers. A difficult piece of work was done by Mr. Wallace while establishing the base-line from the third to the second meridian in the Saskatchewan province, much of the line being through muskegs. It was necessary to flounder, for three months, late in the year, through these half-frozen swamps, and to continue the work during the winter amid the deep

snow and bitter winds of the Pasquia mountains, far from supplies. Other reports deal with the work among the mountains of British Columbia, the most important being that by Mr. Carson on the triangulation survey in the railway belt. Such a survey has been much needed to supply permanent reference points from which to commence all sorts of new surveys, the difficulty of the country prohibiting the adoption here of the elaborate system used in the more level eastern provinces. The survey was commenced in 1889 by Mr. Drewry, but was dropped in 1892, and only resumed in 1906 by Mr. Carson, whose report describes the establishment of a number of mountain stations, and the measurement of a base-line of 427·88 chains ($5\frac{1}{3}$ miles), along the bottom lands of the Columbia river. It also gives many details on the character and resources of the country traversed. Lastly, the general report by the Surveyor-General includes a statement on the initiation and execution of surveys in the Peace river district.

The Labrador Boundary.—For some time a question has been at issue between the governments of Quebec and Newfoundland regarding the true frontier dividing the jurisdictions of the two authorities in Labrador. It has lately reached a more acute stage by reason of the formation of a settlement at Rigolette on Hamilton inlet, and the placing of a customs officer there by the Newfoundland government. Without entering into the merits of the question (which by mutual agreement has been submitted for decision to the Privy Council), it may be of interest to state the main facts bearing on the dispute, as summarized by Archbishop Howley in the *Transactions* of the Royal Society of Canada, Third Series, vol. 1 (Section II., p. 291). As is generally the case in such disputes, the decision is complicated by the somewhat vague wording of the old official documents, which are differently interpreted by the two parties. By the Letters Patent of 1876, which were intended to place the office and jurisdiction of the Governor and Commander-in-chief of Newfoundland and its dependencies on a permanent basis, it was ordered that the area placed under the authority of the governor should include "All the coast of Labrador from the entrance to Hudson's Straits, to a line to be drawn due north and south from Anse Sablon on the said coast to the 52nd degree of north latitude," etc. This somewhat ambiguous statement must be interpreted, as Archbishop Howley points out, by a study of earlier enactments regarding the boundary. By the proclamation which followed the Treaty of Paris in 1763, the government of Quebec was to be "bounded on the Labrador coast by the river St. John, and from thence by a line drawn from the head of that river" to Lake Nipissing, and so on. At the same time it was provided that "all that coast [of Labrador] from the river St. John to the Hudson's straights, together with the islands of Anticosti and the Magdalen and all smaller islands" were to be under the authority of the governor of Newfoundland. After being for a time taken from Newfoundland and given to Quebec, the territory so described, with the exception of the Magdalen islands, was re-annexed to Newfoundland by an Act passed in 1809. In 1825 a final change (as regards the relations between the two jurisdictions) was made by the addition to Quebec of the area between the St. John river and a line running northward from Blanc Sablon (this is said to be the correct name of the spot called Anse Sablon in the Letters Patent of 1875) to 52° N. lat., together with the island of Anticosti. The north-western frontier of Quebec has since been modified (in virtue of authority conferred by the Dominion Act of 1867) by an Act of 1898, which extends the Quebec territory northward to James' bay and the East Main river, and continues the boundary-line eastward by Hamilton river to Hamilton inlet and "the western boundary of the territory under the jurisdiction of Newfoundland;" Quebec's contention being that the "Labrador coast" placed under the governor of Newfoundland consisted only of the strip immediately adjoining the sea. Newfoundland, on

the other hand, maintains the term "coast" was intended to include a certain amount of hinterland, and that from the head of the river St. John to Hudson strait the frontier should be drawn in a straight line. A difference of opinion also exists regarding the northward extension of the coast-line under the jurisdiction of Newfoundland, according to the precise meaning assigned to "Hudson's straits."

The Micmacs of Newfoundland.—A Colonial Report (Miscellaneous, No. 54) by the Governor of Newfoundland gives an account of a visit paid by him last May to the Micmac Indians at Bay d'Espoir, on the south coast of the island. Hailing from Nova Scotia, the Micmacs, over a century ago, entered Newfoundland. Possessed with firearms, and assisted by the white man, they crushed out of existence the aboriginal Beothuks, who knew no arms but bow and arrow. Now numbering 23 families and 131 persons of mixed descent, including one pure Micmac, a woman ninety years of age, they are settled on a reservation on the east side of the Conne arm of the bay. Of good stature and strongly built, Roman Catholic, owning a small church and a small school of 34 children, open since January 17 last, they are hunters and trappers, ignorant of agriculture, seamanship, and fishing. They have to go a score of miles inland for caribou, make deerskin boots, and smoke fish. They also catch a few grouse and hares, which are fast disappearing. The women spin wool and knit stockings. The majority are in rags. Formerly a sawmill, still standing in the reservation, was worked, in spite of Micmac protests; but the trees that grew near the water have all been used up, and none are left for them to bring to the water. The prospects of the settlement are far from bright, yet the Micmacs are expected to continue a separate ethnic unit for several generations.

The Climate of the State of São Paulo, Brazil.—A useful sketch of the leading characteristics of this state, from the point of view of climate, is given in a recent publication of the meteorological section of the 'Directoria de Agricultura' of the state (Ser. 2, No. 3, 1908). The area is divided into three climatic regions—the coast, the high serra, and the plateau, the last occupying by far the greater part of the surface. The coast zone naturally experiences small variations of temperature, while evaporation and precipitation are both considerable, the sea winds supplying abundant moisture. The annual rainfall sometimes exceeds 2000 mm. (79 inches), while the mean annual temperature of 21°·5 C. (70°·7 Fahr.) places this area in the category of the warm temperate regions. The high serra embraces the luxuriantly wooded slopes and summit region of the Serra do Mar, which has a still greater annual rainfall than the coast zone, the moist currents of air being greatly cooled as they ascend the steep sides of the mountains. It amounts, in places, to almost 160 inches. The average of sixteen years' observations gives a mean temperature, at 2625 feet, of 18° C., or 64°·4 Fahr. The degree of cloudiness is a high one, and frost and mist are common, the cold being too great for the growth of coffee. The interior plateau is economically the most important part of the state. It contains the greater number of the towns, and offers the chief agricultural resources. The climate is particularly agreeable and suited for the residence of Europeans, the clearness of the sky increasing, and the relative humidity diminishing, in proportion as one recedes from the coast. Broadly speaking, the chief rains fall in the summer, while the winter is generally clear and calm. The improvements at the capital in the way of drainage, etc., have brought about a sensible diminution of the relative humidity within recent years. A comparison of the climate with that of places within the north temperate zone in the old world shows that though many degrees nearer the equator, the mean annual temperature of the capital (17°·7 C., or 63°·8 Fahr.) is very near that of Palermo, though the difference between the warmest and coldest months is much less (5°·3 C. instead of 14°).

AUSTRALASIA AND PACIFIC ISLANDS.

The Dammköhler-Fröhlich Expedition in German New Guinea.—For some years past the energies of the Germans in New Guinea have been devoted rather to the development of the better-known parts of their possession than to the exploration of new ground. The expedition carried out in 1907 by Herrn Dammköhler and Fröhlich seems, however, to mark a new departure, and, while itself by no means unfruitful in results, may be expected to stimulate further enterprise of the same character. Herr Fröhlich (an expert surveyor) was in charge of an expedition to the neighbourhood of the Markham river, the important stream which debouches into Huon gulf; and finding that Herr Dammköhler, an experienced explorer of German New Guinea, was at the same time planning an advance into the interior from the same locality, he decided to join forces with him. The natives on the coast to the north of the Markham were found to have abandoned their villages in consequence of raids from the interior peoples, and this somewhat hampered the preparations for the start; but a party of fifteen porters, belonging to a variety of different tribes, was at last organized. The route led first up the small Bumbu river, and afterwards skirted the northern edge of the lowlying grassy plain of the Markham, occasionally ascending some of the spurs of the Rawlinson range, from which views over the country ahead were obtained. At first such natives as were seen kept their distance; but on reaching a more inhabited area they assumed a threatening attitude, and for a couple of days the explorers were surrounded by suspicious crowds, though serious hostilities were fortunately avoided. On turning an angle of the northern hills a pleasing confirmation was obtained of Herr Dammköhler's view that the plain would be found to extend inland towards that of the upper Ramu (the great river explored by Dr. Lauterbach in the nineties of last century), with no intervening barrier of mountains. After crossing many streams descending from the Rawlinson range towards the Markham, the headstream of the latter was itself crossed. It was a large river, some 500 yards in width. The plain beyond was thickly peopled with friendly natives, who, like the hostile tribe previously met with, were of exceptionally fine physique. They had never before come into contact with white men, and were still living in the Stone Age, being quite at a loss how to use the knives presented to them. The plain was thickly covered with coconut groves, but was otherwise grass-clad, possibly owing to the constant grass-burnings, which may have destroyed a former forest. The divide towards the Ramu was crossed at an altitude of about 1300 feet, and after reaching the junction of the two chief headstreams of that river (the more northern of which descends from the Finisterre range), the expedition took a more northerly course for Astrolabe bay. A rugged mountainous country was crossed, through which the only path was frequently in the narrow beds of the torrents, and, after crossing the divide and striking the Kabenau river, the party eventually reached the station of Konstantinhafen, on Astrolabe bay. In the mountainous tract friendly natives of relatively small stature were met with. The views to the south obtained during the journey gave no indication of a break between the Krätke and Bismarck ranges of our maps, the mountains appearing to form an unbroken wall beyond the plains of the Markham and Ramu. Herr Fröhlich (who describes the expedition in the *Mitt. aus den Deutschen Schutzgebieten*, 1908, No. 4) thinks that the route opened by it will supply the best line of approach to the unexplored country in that direction. He also dwells on the economic importance of the interior plains, which, he says, are drier and healthier than the coast regions. It was only rarely that mosquitoes gave any trouble during the journey.

The Sapper-Friederici Expedition in the Bismarck Archipelago.—This

expedition was referred to in the *Journal* for December last (p. 624). A further report from Dr. Friederici (who did not return to Europe with Dr. Sapper) has since been received in Germany (*Deuts. Kolonialblatt*, February 1, 1909), describing that traveller's attempt to cross the northern part of New Pomerania (New Britain) from coast to coast. From Herbertshöhe he took passage in a small sailing vessel to Open bay on the west side of the Gazelle peninsula, but was much delayed, and found his supplies depleted before being able to push far inland. Having reached a palisaded village of a section of the Baining people (who have hitherto had little intercourse with white men), he was told that there was absolutely no route to the east coast, and as it would have been hazardous to attempt to cut a way through the uninhabited bush, he was forced to give up his project. He was able to glean some ethnological information, and took ninety-one measurements of the Baining people, including their chief, Kambule, who is only 4 feet 8½ inches in height. Dr. Friederici draws a sharp contrast between travel in New Mecklenburg and New Pomerania, all of the latter at any distance from Herbertshöhe being an unknown wilderness. He is expected to arrive in Germany during March.

GENERAL.

Father Yves d'Evreux.—The *Journal de la Société des Américanistes de Paris*, New Series, vol. 5, No. 2, contains a short notice (since published separately) by Gabriel Marcel, of the "Apostle" of the Tupinambas, well known by his 'Voyage dans le nord du Brésil fait durant les Années 1613 et 1614.' M. Marcel's article serves a useful purpose in bringing together the few known particulars of the missionary's life, to be gathered from F. Denis's edition (1864) of the 'Voyage,' from a small and little-known tract by Dr. Semelaigne ('Le P. Yves d'Evreux ou Essai de Colonisation au Brésil,' etc.) published in 1887, and from a notice, by Père E. d'Alençon, published in 1894, on the 'Convent des Capucins d'Evreux.' The following few items comprise all the indications of Yves' life down to the assumption of his mission in Brazil. Dr. Semelaigne first discovered the missionary's family name engraved on a slab in the wall of the church of Normanville, in the arrondissement of Evreux, where the remains of Yves and his father rest. A longish inscription gives the name of Simon Michellet as common to both. Both founded obits, and in order to their discharge bequeathed to the church three specified pieces of land. If not born in Normanville, the missionary must have at least belonged to the diocese of Evreux. His birthplace is not more explicitly indicated in a manuscript of the Bibl. Mazarine cited by d'Alençon. The year 1577, assigned by Denis as that of the missionary's birth, is adopted by Marcel, in lack of any evidence tending to its correction. The 'Voyage' informs us how he was well instructed in Latin, Greek, and Hebrew, and made his novitiate in the Capuchins' convent of Rouen. To the renown enjoyed by the Capuchins for effecting the conversion of Count de Bouchage and the abjuration of Archange de Vernbroke is imputed the fact that the Queen-Regent addressed a letter to the Capuchins of Paris, asking for four missionaries for the island of Maranhão, to accompany an expedition for the colonization of the north of Brazil. Among the four selected was Yves, to whom the direction of the missions was confided. The little fleet set sail on March 19, 1612, but ill health compelled Yves to return to France in 1614.

OBITUARY.

Wilfred Hudleston, F.R.S.

By the death of Wilfred Hudleston the Society has lost a Fellow of considerable experience as a traveller and of great eminence as a geologist. He was the eldest son of John Simpson, M.D., of Knaresborough (who married Elizabeth Ward, heiress of the Hudlestons of Cumberland), but he assumed the name of Hudleston in 1867. Born in 1828, he was educated at St. Peter's College, York, at Uppingham, and at St. John's College, Cambridge. In 1850 he graduated B.A., and in 1853 was called to the Bar, but he never practised. He married, in 1890, Rose Matilda, second daughter of the late William Heywood Benson, who survives him.

As a young man, Hudleston's interests lay chiefly in ornithology, in the pursuit of which he went to Lapland in company with Prof. Alfred Newton and Mr. John Wolley. Subsequently he visited Algeria, Greece, and Turkey with the same object, always, however, with a keen eye for the geological features of the regions he traversed. After attending a course of chemistry at Edinburgh and three sessions at the Royal College of Chemistry in London, he made the acquaintance of Prof. John Morris, under whose influence geology became the principal study of his life. In 1867 he was elected a Fellow of the Geological Society of London, and in 1871 joined the Geologists' Association.

Then, as now, the excursions organized by the Association gave geologists the opportunity of examining the most interesting sections in the country under the ablest guidance. Hudleston not only took advantage of these opportunities, but, becoming secretary in 1874, himself organized the excursions and prepared reports upon them, some of which still constitute classic geological literature. In 1881 he was elected President, and to the day of his death maintained his interest in the Association, in connection with which so much of his scientific work had been done.

In 1884 he was elected a Fellow of the Royal Society of London. From 1886 to 1890 he served as one of the secretaries of the Geological Society of London, and in 1892 succeeded Sir Archibald Geikie as President. Three years later the Council awarded to him the highest honour it was in their power to bestow, the Wollaston Medal. He himself was frequently a member of the Council, and, in fact, was a member at the time of his death.

He was connected with several other scientific societies. The Devonshire Association for the advancement of Science, Literature, and Art, and the Yorkshire Naturalists' Union, both selected him as President, and in 1898 he presided over the geological section of the British Association at Bristol. He was elected to the Royal Geographical Society in 1871, and has served on the Council.

In the long list of papers by which Hudleston has enriched geological literature those by which he is best known are probably his memoir on the Corallian Rocks of England, written in collaboration with the late Prof. J. F. Blake, and his Monograph on the Inferior Oolite Gasteropoda, which was published by the Palæontographical Society. For the purposes of the latter work he himself collected, or caused to be collected, fossils from all occurrences of those rocks in the country, verifying with the utmost care the exact horizon on which every specimen was found. These and other collections which he acquired are admirably arranged in a museum in his house in London. The work he devoted to them had rendered him one of the greatest living authorities in the country on Oolitic mollusca, and enabled him to write an able criticism on the view put forward by Mr. J. E. S. Moore, that the gasteropoda of Lake Tanganyika may be regarded as descendants of Inferior Oolite forms. This led

him further to discuss the continental features, with the result that he produced one of the ablest treatises on the physiography of that part of Africa which we possess. He extended his researches into Palestine also.* Shortly before his death he was engaged in sorting out the Dorset specimens in his collection with a view to presenting them to the Dorset County Museum.

On January 29, 1909, he died suddenly, having retained his alertness and acuteness of judgment up to the last moment. Held in the highest esteem by all who had come into contact with him during his long life, at the same time his tenacity of opinion and uncompromising expression of it compelled respect. He never spoke an idle word nor formed an ill-considered conclusion. A formidable opponent in scientific controversy, he was the staunchest of friends, and he leaves a gap which will not easily be filled.

A. S.

J. B. Du Fief.

We record with much regret the death, in his eightieth year, of our Honorary Corresponding Member, Prof. J. Du Fief, the able and zealous secretary of the Royal Belgian Geographical Society of Brussels, with which his name had been associated since its foundation in 1876. He had been in failing health for some time, and his death, which took place on December 13, 1908, was not unexpected, though he had clung gallantly to his work almost to the last. Some account of his life may be gathered from the report of discourses pronounced in his honour at his funeral, given in the *Bulletin* of the society with which he was so long connected (1908, No. 5).

Born at Chercq, near Tournai, in 1829, he acquitted himself with distinction in his studies at Namur, and soon entered upon the profession of teacher, occupying the chairs of geography at Tournai, Hasselt, Antwerp, and Brussels. He published various works connected with geographical education, including an atlas of modern and historical geography, and a relief map of Belgium. In later years he brought out a map of the Congo Independent State on the scale of 1 : 2,000,000. But it is for the share which he took in the foundation of the Royal Belgian Geographical Society, and for his untiring efforts in its behalf, that he will chiefly be remembered. The final impetus towards the formation of such a society was given during the Paris meeting of the International Geographical Congress in 1875, Du Fief undertaking the practical steps to carry the idea into execution. Such ardour did he throw into the task that the new society came into existence in August, 1876, 600 members having already been enrolled when the inaugural meeting took place at Brussels. Du Fief held the office of General Secretary from the first, and through the next thirty years may be said to have been the mainspring of all its activities. When, in 1894, De Gerlache set on foot his scheme for a Belgian Antarctic Expedition, it was only when he had secured the active co-operation of Du Fief that difficulties began to be vanquished; and when the voyage had been decided on, it was largely to his untiring efforts that its successful organization was due. He represented his society at many meetings of geographers abroad (including the London meeting of the International Geographical Congress in 1895), and at the society's jubilee in 1901 he was justly regarded as the central figure in the celebration. He had been an Hon. Corresponding Member of our Society since 1887.

* A complete list of his works up to the year 1904 will be found in the *Geological Magazine* for 1904, p. 436. To the article, of which that list forms part, we are indebted for much of the information on which this notice is founded.

Ernest Favenc.

Mr. Ernest Favenc, the announcement of whose death has just reached us from Australia, was known for several successful exploratory journeys in various parts of that continent, but still better perhaps as the author of a carefully compiled history of Australian exploration, based on the most authentic records available at the time of its publication (1888). Though he had contributed a paper to our *Proceedings* as far back as 1889, it was only towards the end of last year that he became a candidate for election as a Fellow. His election took place on November 16 last, but his death occurred before the intimation of it had reached Australia, so that he was never aware of it himself.

Mr. Favenc's first journey of exploration was made in 1878–79. It was known as the *Queenslander* Trans-continental Expedition, having been organized through the initiative of that newspaper, with a view to examining the country along the line of a proposed railway to Port Darwin, which in part passed through unexplored country. The starting-point was Blackall, then the most advanced settlement in the interior of Queensland, a little west of the Great Dividing range. Thence the expedition made its way in a west-north-westerly direction, crossing the Queensland frontier into the Northern Territory, and finally striking the overland telegraph line at Powell's creek. Some new ground was broken and various creeks were discovered in about 19° S., while the expedition brought to light a considerable extent of pastoral country which has since been settled. In 1882–83 he carried out some further explorations between the telegraph line, the Queensland border, and the Gulf of Carpentaria, especially in the basin of the Macarthur river, where some good land was found. In 1888 his exploring energies were directed to quite another part of Australia, that watered by the Gascoyne and Ashburton rivers in Western Australia. On an expedition which left Champion bay in March of that year he was accompanied by Mr. W. R. Cuthbertson as surveyor, and some good geographical work was accomplished, especially in the upper basin of the Ashburton, several previously unknown tributaries of which were brought to light. The country through which they flowed was described by the explorer as magnificent pastoral country likely to become valuable sheep-runs (see *Proc. R.G.S.*, 1889, pp. 492–496).

In addition to the book above mentioned (which was brought out under the auspices of the Governments of the Australian colonies), Mr. Favenc was the author (besides minor writings) of a work entitled 'Western Australia: its Past History, its Present Trade and Resources, etc.,' published at Sydney in 1887. Only last summer he had once more dealt with the history of Australian exploration in a work published under the title, 'The Explorers of Australia and their Life Work.'

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1908–1909.

RESEARCH DEPARTMENT.

January 21, 1909.—Dr. A. Strahan, Chairman, in the Chair.

"Geographical Distribution of Rainfall in Wales." By S. B. Williams.

January 26, 1909.—Dr. A. Strahan, Chairman, in the Chair.

"Scheme for a Sledge Expedition across the North Polar Area during the Winter." By A. H. Harrison.

Seventh Meeting, January 25, 1909.—Major LEONARD DARWIN, President, in the Chair.

ELECTIONS.—*Lieut.-Colonel Colin Powys Campbell*: *Captain the Hon. G. H. Douglas-Pennant (late Grenadier Guards)*; *John Fletcher Haworth*; *William Harvey Hildreth*; *Rev. Isaac Levinson*; *Hector Rumfurd*; *Louis G. Schlesinger*; *Captain H. S. P. Simon*; *Captain W. J. Stomm*; *Leslie Alfred Edward Swinney*; *Captain R. Walker, R.E.*

The paper read was:—
"A proposed North Polar Expedition." By Captain Roald Amundsen.

Eighth Meeting (Special in the Queen's Hall), *February 8th*, 1909.—Major LEONARD DARWIN, President, in the Chair.

ELECTIONS.—*Alan Henry Brodrick*; *Stuart Donnithorne*; *Henry P. M. Finkler*; *Frank George Fisher*; *Captain A. W. Jennings-Bramley*; *J. R. Kerby*; *J. M. Kerr*; *Hon. Francis Lindley*; *Captain Charles Elmhurst Luard, D.S.O.*; *Oliver H. M'Cowen*; *William James White Nicol*; *A. W. Ferris Taylor*; *Fritz Zimmern*.

HONORARY CORRESPONDING MEMBER.

Dr. Silva Telles, Secretary of the Lisbon Geographical Society.

The paper read was:—
"My Recent Expedition in Tibet." By Dr. Sven Hedin.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps—Phytogeography. *Vegetationsbilder (Karsten, etc.)* **6** (1908): *Plates* 25–36. **Schenck.**

Alpine Vegetation. Von Dr. Heinrich Schenck. *Illustrations.*

Austria—Bohemia. *M. k.k. G. Ges. Wien* **51** (1908): 161–204. **Sellner.**

Geomorphologische Studien und Beobachtungen aus dem südlichen Böhmerwalde. Von Dr. Alois Sellner.

Austria—Cartography. *M. k.k. G. Ges. Wien* **51** (1908): 149–160. **Peucker.**

Der österreichische Topograph Johann Christoph Müller (1673–1721) und die vaterländische Kartographie. Von Dr. Karl Peucker.

Austria—Karst. *Globus* **94** (1908): 297–301. **Perks.**

Zur Hydrographie des istrischen Karstes. Von G. And. Perks.

Austria—Surveys. *M. k.k. Militärg. I., Wien* **27** (1907): 47–81. ——

Die Fortsetzung des Präzisionsnivellements, ausgeführt in den Jahren 1904 bis 1907.

Balkan Peninsula—Phytogeography. *Petermanns M.* **54** (1908): 195–203. **Adamović.**

Die Vegetationsstufen der Balkanländer. Von Prof. Dr. L. Adamović. *Maps.*

Switzerland. **Knapp and others.**

Geographisches Lexikon der Schweiz: mit dem Beistande der Geographischen Gesellschaft zu Neuenburg herausgegeben unter der Leitung von Charles Knapp, Maurice Borel, und V. Attinger. Deutsche Ausgabe, besorgt von Heinrich Brunner. V. Band: Schweiz-Tavetsch. Neuenburg: Gebrüder Attinger, 1908. Size 11 × 7½, pp. iv. and 768. *Maps, Plans, and Illustrations. Presented by Dr. H. Brunner.*

United Kingdom—Cartography. **Fordham.**

Notes on the cartography of the counties of England and Wales. By Herbert George Fordham. Hertford, 1908. Stephen Austin & Sons. Size 8½ × 6½, pp. 12. *Presented by the Author.*

Interesting notes on the history of English county maps.

United Kingdom—Cornwall. **Macalister.**

Geological aspect of the lodes of Cornwall. By Donald A. Macalister. (Reprinted from *Economic Geology*, vol. 3, No. 5, July–August, 1908.) Size 10 × 7, pp. 363–380 *Sketch-map.*

United Kingdom—Ireland. **Inglis.**

The "Contour" Road Book of Ireland. A series of elevation plans of the roads, with measurements and descriptive letterpress. From special surveys by Harry R. E. Inglis. Edinburgh: Gall & Inglis, 1908. Size 6 × 3½, pp. xvi., 256, and 16. *Map and Sections. Presented by the Publishers.*

United Kingdom—London. ——

Report from the joint select committee of the House of Lords and the House of Commons on the Port of London Bill; together with the proceedings of the committee, minutes of evidence, and appendices. London: Wyman & Sons, 1908. Size 13 × 8½, pp. xxviii. and 686. *Price 5s. 7d.*

United Kingdom—Scotland. **Harker and Barrow**

Memoirs of the Geological Survey: Scotland. The geology of the small isles of Inverness-shire (Rum, Canna, Eigg, Muck, etc.) By Alfred Harker; with contributions by G. Barrow. Glasgow, 1908. Size 9½ × 6, pp. x. and 210. *Sketch-maps, Sections, and Illustrations.*

United Kingdom—Scotland. *Geological Mag.* **5** (1908): 396–408. **Hickling.**

The Old Red Sandstone of Forfarshire, Upper and Lower. By George Hickling. *Sketch-maps and Illustrations.*

United Kingdom—Scotland. *Scottish G. Mag.* **24** (1908): 449–464. **Richardson.**

The influence of the natural features and geology of Scotland on the Scottish people. By Ralph Richardson.

United Kingdom—Scotland. *T.R.S. Edinburgh* **41** (1907–8): 1–32. **Kendall and Bailey.**

The Glaciation of East Lothian south of the Garleton hills. By Professor P. F. Kendall and Mr. E. B. Bailey. *Map, Illustrations, and Diagrams.*

ASIA.

Ceylon. *Le Globe; Mém. S.G. Genève* **47** (1908): 1–32. **Sarasin.**

Unsere vierte (Paul und Fritz Sarasin's) Forschungsreise nach Ceylon und die Steinzeit der Weddas. Von Dr. Fritz Sarasin.

China. ——

China. Report for the year 1907 on the Trade and Commerce of the district of Chinan Fu. Diplomatic and Consular Report, Annual Series, No. 4159 (1908). Size 9½ × 6, pp. 24. *Sketch-maps. Price 5d.*

China—Yangtse Valley. ——

China. Report on the Physical, Commercial, Social, and General conditions of Ichang and neighbourhood. Diplomatic and Consular Reports. Miscellaneous Series, No. 671, 1908. Size 9½ × 6, pp. 24. *Sketch-map. Price 3d.*

Chinese Empire. **Kozloff.**

Mongolia and Kam. Works of the Imperial Russian Geographical Society's Expedition during 1899–1901, under the command of P. K. Kozloff. Vol. 7, Arthropoda. Part i. St. Petersburg, 1908. Size 12½ × 9, pp. 1–150. *Illustrations. Presented by the Imperial Russian Geographical Society.*

Philippine Islands—Minerals. **Smith.**

The Bureau of Science, Manila. The mineral resources of the Philippine islands. With a statement of the production of commercial mineral products during the year 1907. Issued by Warren D. Smith. Manila, 1908. Size 10½ × 7½, pp. 40. *Maps and Illustrations.*

Russia—Siberia. *M.G. Ges. Hamburg* **23** (1908): 289–298. **Grigorieff and Michow.**

Originalkarte Sibiriens aus dem 17. Jahrhundert. Ein Werk Ssemen Rémesow's, nach dem Russischen des Prof. Alexander Wassiljewitsch Grigoriev von H. Michow. *Facsimile Map.*

See note in the *Journal* for April, 1908, p. 442.

Russia—Siberia. *J. Tōkyō G.S.* **20** (1908): 395–403. **Suzuki.**

The sea of Okhotsk and the Coast of Kamtchatka. By Yōnosuke Suzuki. [In Japanese.]

Siam—Surveys. ——

Siam. General Report on the operations of the Royal Survey Department, season 1905–1906. Bangkok: Printed at "The American Presbyterian Mission Press." 1908. Size 13 × 8½, pp. 66. *Maps, Chart, Plans, and Illustrations. Presented by the Royal Survey Department, Bangkok, Siam.*

Good progress seems to have been made during the year. The operations included a triangulation and traverse survey in the province of Chantabon, evacuated by France in 1905.

Turkey—Asia Minor—Agriculture. **Dunstan.**

Report on Agriculture in Asia Minor, with special reference to cotton cultivation. By Prof. Wyndham Dunstan. London: Wyman & Sons, 1908. Size 13 × 8½, pp. 18. *Sketch-map. Price 1s.*

See note in the February number, p. 212.

Turkey—Railway. *Rev. française* **33** (1908): 505–516. **Vasco.**

Le chemin de fer musulman du Hedjaz. Par Gabriel Vasco. *Sketch-map.*

AFRICA.

Abyssinia. *Petermanns M.* **54** (1908): 1–15, 99–114. **Bieber.**

Das Hochland von Südäthiopien. Reisebericht von Friedrich J. Bieber. *Map.*

Some account of the journey was given in vol. **27**, p. 503.

Africa. **Kan.**

Het Afrika-vraagstuk. Door Dr. C. N. Kan. Haarlem: H. D. T. Willink & Zoon, 1909 [1908] Size 9 × 6, pp. 170. *Map. Presented by the Author.*

Miscellaneous notes on the history and economic development of the continent.

Algeria—Relief. *Globus* **94** (1908): 169–174. **Passarge.**

Morphologische Skizze des Atlas zwischen Philippeville und Biskra. Von S. Passarge. *Section.*

Algeria and Tunis. *G. Ts., K. Danske G.S.* **19** (1907–8): 269–285. **Steensby.**

Nogle etnografiske Iagttagelser fra en Rejse i Algier og Tunis 1908. Af Dr. H. P. Steensby. *Illustrations.*

French Sahara. *B.S.G. Alger* **13** (1908): 141–180. **Cauvet.**

Les sables du Sahara Algérien. Par le Commdt. Cauvet. *Illustrations.*

On the general physical characters of the region of sand-dunes.

French Sahara. *B.S.G. Alger* **13** (1908): 302–324. **Saint-Léger.**

Reconnaissance de la région de Bir-Hadjaj. Par le Lieut. de Saint-Léger.

Bir Hajaj is a well on the route from Adrar to Taodeni.

Kamerun—Exploration. *Z. Kolonialpolitik* **10** (1908): 557–575. **Passarge.**

Die Geschichte der Erforschung und Eroberung Kameruns. Von Prof. Dr. Siegfr. Passarge.

Kamerun—Native Geography. *Globus* **94** (1908): 206–209. **Struck.**

König Ndschoya von Bamum als Topograph. Von Bernhard Struck. *Facsimiles.*

Madagascar—Historical. *La G., B.S.G. Paris* **18** (1908): 1–22. **Grandidier.**

Européens et Malgaches: leurs relations aux siècles passés. Par G. Grandidier.

Mauritius—Observations. **Claxton.**

Annual report of the Director of the Royal Alfred Observatory for 1905. By T. F. Claxton. (*N.p., n.d.*) Size 13½ × 8½, pp. 32. *Diagram.*

Gives, in abstract, the results of the meteorological and magnetic observations, both at the observatory and other stations, including observations of the weather over the Indian ocean obtained from ships' logs.

Mauritius—Observations. **Claxton.**

Results of the Magnetical and Meteorological Observations made at the Royal Alfred Observatory, Mauritius, in the year 1905. Under the direction of T. F. Claxton. London: Eyre & Spottiswoode, 1907. Size 12 × 9½, pp. xxxiv. and lxvi. *Diagrams.*

Records of earthquake shocks taken by a Milne seismograph are included.

Morocco. *B.S.G. Alger* **13** (1908): 1–16. **Brives.**

Les Beni-Snassen (Maroc). Par A. Brives. *Illustrations and Section.*

These people occupy a small mountain massif near the Algerian frontier, a visit to which is described by the author.

Rhodesia—Minerals. **Lett.**

More about Zambesia Minerals. By Stephen J. Lett. (Reprinted from the *Mining Journal*, August–September, 1908.) Size 11 × 8½, pp. 8. *Sketch-map.*

Sahara—Phytogeography. **Brockmann-Jerosch and Heim.**

Vegetationsbilder (*Karsten and Schenk*) **6** (1908): *Plates* 19–24.

Vegetationsbilder von Nordrand der algerischen Sahara. Von Dr. H. Brockmann-Jerosch und Dr. Arnold Heim. *Illustrations.*

Togo. *Globus* **95** (1908): 197–200. **Seidel.**

Der Wassermangel des Haho und Schio und die Mittel zu seiner Bekämpfung. (Eine kolonial-geographische Skizze aus Togo.) Von H. Seidel. *Map.*

Transvaal. **Trevor and others.**

Transvaal Mines Department. Report on a Reconnaissance of the North-Western Zoutpansberg District. By T. G. Trevor and E. T. Mellor, with an introduction by H. Kynaston. Pretoria, 1908. Size 9½ × 6, pp. 40. *Map, Plan, Section, and Illustrations. Price 2s. 6d.*

Uganda—Ethnology. **Hattersley.**

The Baganda at home. By C. W. Hattersley. London: The Religious Tract Society, 1908. Size 8½ × 5½, pp. xvi. and 228. *Sketch-map and Illustrations. Price 5s. net. Presented by the Publishers.*

West Africa. *La G., B.S.G. Paris* **18** (1908): 64–73. **Cottes.**

La sylve équatoriale et les anthropophages: Pahouins et Pygmées. Par le Captain Cottes. *Map.*

NORTH AMERICA.

Alaska **Erdmann.**

Alaska. Ein Beitrag zur Geschichte nordischer Kolonisation. Bericht, dem Herrn Minister der Geistlichen, Unterrichts-, und Medizinal-Angelegenheiten erstattet von Prof. Dr. H. Erdmann. Berlin: D. Reimer, 1909 [1908]. Size 10 × 6½, pp. xvi. and 224. *Map and Illustrations. Price* 8*m. Presented by the Publisher.*

Alaska—Glaciers. *M.V.E. Dresden*, 1907 (1908): 55–70. **Partsch.**

Alaskas Bedeutung für die Gletscherforschung. Von J. Partsch.

Canada. ———

Annual Report of the Department of the Interior for the fiscal period from July 1, 1906, to March 31, 1907. Ottawa. S. E. Dawson, 1907. Size 9½ × 6½, pp. xlix. and 416. *Presented by the Surveyor-General.*

Part 3 forms the annual report on surveys, also issued separately (see *ante*, p. 330).

United States—Kentucky and Virginia. *U.S. Geol. Surv. B.* **348** (1908): pp. 128. **Stone.**

Coal resources of the Russell Fork Basin in Kentucky and Virginia. By Ralph W. Stone. *Maps, Illustrations, and Sections.*

United States—Michigan. *J. Geology* **16** (1908): 459–476. **Goldthwait.**

A reconstruction of water plans of the extinct glacial lakes in the Lake Michigan basin. By James Walter Goldthwait. *Maps and Sections.*

United States—Mississippi. *B.G.S. Philadelphia* **6** (1908): 9–26. **Tower.**

The Mississippi River Problem. By Dr. Walter Sheldon Tower.

Discusses the scheme for a deep waterway from the great lakes to the Gulf of Mexico.

United States—New Mexico. *J. Geology* **16** (1908): 438–451. **Keyes.**

Geotectonics of Estancia Plains. By Charles R. Keyes. *Illustration and Sections.*

United States—North Dakota. *B. American G.S.* **40** (1908): 321–332, 401–415. **Craig.**

North Dakota Life: Plant, Animal, and Human. By Wallace Craig.

United States—North-East. **Penhallow.**

P. and T.R.S. Canada, Ser. III. **1** (1907): Sect. 4, 13–56.

A contribution to our knowledge of the origin and development of certain marsh-lands on the coast of New England. By Dr. D. P. Penhallow. *Map and Illustrations.*

United States—Resources. *B.G.S. Philadelphia* **6** (1908): 10–19. **Johnson.**

The Conservation Movement. By Dr. Emory R. Johnson.

In support of the movement for the better husbanding of the resources of the United States.

United States—Texas. **Clark.**

The Beginnings of Texas, 1684–1718. By Robert Carlton Clark. (Bulletin of the University of Texas, No. 98. Austin, 1908.) Size 9 × 6, pp. 94. *Map. Presented by the Librarian, University of Texas.*

CENTRAL AND SOUTH AMERICA.

Brazil—São Paulo. ———

Commissão Geographica e Geologica do Estado de S. Paulo. Exploração do rio Ribeira de Iguape. S. Paulo, 1908. Size 17½ × 13, pp. iv. and 34. *Maps and Illustrations. Presented by the Commission.*

Central and South America. **Mackellar.**

A pleasure pilgrim in South America. By C. D. Mackellar. London: J. Murray, 1908. Size 9 × 6, pp. xii. and 408. *Illustrations. Price* 15*s. net. Presented by the Publisher.*

Chile—Frontier. **Patron.**

República de Chile: Oficina de Límites. La línea de frontera con la República Arjentina entre las latitudes 35° i 46° S. Por Luis Riso Patron. Santiago, 1907. Size 11 × 7½, pp. 450. *Maps and Illustrations. Presented by the Oficina de Mensura de Tierras, Chile.*

Peru and Bolivia—Boundary. **Belaunde.**

La cuestión de límites Peruano-Boliviana ante el Arbitro Argentino. Resumen de las pruebas y argumentaciones aducidas. Por Victor Andrés Belaunde.

(Boletim del Ministerio de Relaciones Exteriores Año vi., Núm. xxv.) Lima, 1908. Size 9½ × 6½, pp. 284. *Map.*

A summary of the arguments and replies of the two powers presented to the Argentine republic as arbitrator under the treaty of 1902.

West Indies—Geology. **Ells.**

P. and T.R.S. Canada, Ser. III. **1** (1907): Sect. IV., 115–130.

Notes on the geology of the islands of Trinidad and Barbados, British West Indies. By Dr. R. W. Ells.

AUSTRALASIA AND PACIFIC ISLANDS.

Caroline Islands. *M. Deuts. Schutzgebieten* **21** (1908): 169–186. **Krämer.**

Studienreise nach den Zentral- und Westkarolinen. Von Prof. Dr. Augustin Krämer. *Map.*

See Monthly Record, February, p. 217.

New Guinea—Ethnology. **Pöch.**

Zweiter Bericht über meine phonographischen Aufnahmen in Neu-Guinea (Britisch-Neu-Guinea vom 7. Oktober 1905 bis zum 1. Februar 1906). Von Dr. Rudolf Pöch. (Aus dem Sitzungsberichten der K.A.W., Wien; Bd. cxvi., Abt. IIa., April 1907.) Vienna, 1907. Size 9½ × 6, pp. 18. *Illustrations.*

New Guinea—German. *M. Deuts. Schutzgebieten* **21** (1908): 200–213. **Fröhlich.**

Durch das Innere von Kaiser-Wilhelmsland von Huon-Golf bis zur Astrolabe-Bai. (Expedition Dammköhler-Fröhlich.) Von O. Fröhlich. *Map and Illustrations.*

Noticed in the Monthly Record, *ante*, p. 333.

POLAR REGIONS.

Arctic Ocean. *Mem. on Hydrography* **28** (1907): 311–359. **Akhmatof.**

Astronomical and geodetic work with an expedition to the Arctic ocean in the summer of 1904. By V. Akhmatof. *Illustrations and Diagrams.* [In Russian.]

Greenland. *La G., B.S.G. Paris* **18** (1908): 169–176. **Rabot.**

L'expédition Mylius Erichsen dans le Grönland nord-orientale. Par Charles Rabot. *Map.*

Greenland. *G. Ts., K. Danske G.S.* **19** (1907–8): 263–268. **Trolle.**

Summarisk Oversigt over *Danmark* Expeditionens Forløb og Arbejder. Ved A. Trolle. *Sketch-map and Illustrations.*

MATHEMATICAL GEOGRAPHY.

Cartography. *M. k.k. Militärg. I., Wien* **27** (1907): 82–95. **Dittrich.**

Geologie und Kartographie in ihrer gegenseitigen Beziehung bei der Terraindarstellung in Karten. Von Gustav von Dittrich. *Maps.*

Cartography—Projection. *Petermanns M.* **54** (1908): 161–163. **Frischauf.**

Zur Wahl der Projektion für Karten grossen und mittlern Massstabs. Von Prof. Dr. Johannes Frischauf. *Diagram.*

Compass Deviation. *Ann. Hydrographie* **36** (1908): 461–464. **Bidlingmaier.**

Schwingungsbeobachtungen mit der Horizontalnadel auf See. Zusammenstellung der Erfahrungen auf der deutschen Südpolar Expedition. Von Dr. Fr. Bidlingmaier.

Geodesy. **Wade.**

Lunar observations and the figure of the Earth. By E. B. H. Wade. (Reprinted from the *Cairo Scientific Journal*, vol. **2**, No. 22, July, 1908.) Size 11 × 7½, pp. 4.

Time and Latitude. **Obrecht.**

Observatorio Astronómico de Santiago de Chile. Determinacion de la hora y de la latitud jeografica de un lugar por la observacion de los momentos en que las alturas de algunas estrellas son igualos. Por A. Obrecht. Santiago, 1907. Size 9 × 6, pp. 294.

The bulk of the volume is taken up with tables of pairs of stars, giving the data necessary for the above determination.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geomorphology—Valleys. *Geol. Mag.* **5** (1908): 529–534. **Jukes-Browne.**
The rôle of solution in valley-making. By A. J. Jukes-Browne. *Sketch-map.*

Geophysics. *Science* **28** (1908): 697–713, 737–743. **Joly.**
Uranium and geology. By Prof. John Joly.

Geophysics. **See.**
Further researches on the physics of the Earth, and especially on the folding of mountain ranges and the uplift of plateaus and continents produced by movements of lava beneath the crust arising from the secular leakage of the ocean bottoms. By Dr. T. J. J. See. (Reprinted from *Proceedings of the American Philosophical Society, Philadelphia*, vol. **47**, 1908.) Size 7½ × 6½, pp. 157–275. *Maps and Sections. Presented by the Author.*

Hydrology. *C.R.A. Sc. Paris* **147** (1908): 606–608. **Maillet.**
Sur une loi hydrologique de Minard et Belgrand. Note de E. Maillet.

Hydrology. *J. Scottish Meteorol. S.* **14** (1908): 225–230. **Smith.**
The relation of rainfall to the depth of water in a well. By James Smith. *Section and Diagrams.*

Ice. **Buchanan.**
Ice and its natural history. By J. Y. Buchanan. London: William Clowes & Sons, [*n.d.*]. Size 8½ × 5½, pp. 34. *Illustrations and Diagrams. Presented by the Author.*

Landslides. *B.S. Belge Géologie* **22** (1908): *Procès Verbaux* 10–22. **Grégoire.**
Note sur les terres coulantes. Par A. Grégoire. *Diagram.*

Limnology. *J. Scottish Meteorol. S.* **14** (1908): 219–224. **Wedderburn.**
The freezing of fresh-water lakes. By E. M. Wedderburn.

Meteorology—Circulation. *Science* **28** (1908): 415–416. **Schaeberle.**
An explanation of the cause of the eastward circulation of our atmosphere. By J. M. Schaeberle. Size 10½ × 8. *Also separate copy.*
The cause assigned is the change of angular velocity acquired by ascending air-currents.

Meteorology—Pressure. *Quarterly J.R. Met. S.* **34** (1908): 165–188. **Rawson.**
The anticyclonic belt of the southern hemisphere. By Colonel H. E. Rawson.
See note by the author in the *Journal* for August last (p. 178).

Meteorology—Wind. **Gold.**
Report to the Director of the Meteorological Office on the calculation of wind velocity from pressure distribution, and on the variation of meteorological elements with altitude. By Ernest Gold. London, 1908. Size 12 × 10, pp. 44. *Diagrams. Presented by the Meteorological Office.*

Oceanography—Atlantic Ocean. *Ann. Hydrographie* **36** (1908): 406–410. **Schott.**
Die Bedeutung einer internationalen Erforschung des Atlantischen Ozeans in physikalischer und biologischer Hinsicht. Von G. Schott. *Also separate copy, presented.*

Oceanography—Persian Gulf. *Ann. Hydrographie* **36** (1908): 296–299. **Schott.**
Der Salzgehalt des Persischen Golfes und der angrenzenden Gewässer. Von Prof. Dr. Gerhard Schott. *Charts.*

Oceanography—Plankton. *J. Linnean S., Zoology* **30** (1908): 198–238. **Norman.**
The Podosomata (= Pycnogonida) of the temperate Atlantic and Arctic Oceans. By Canon A. M. Norman. *Illustrations.*

Oceanography—Voyage. *M.G. Ges. Hamburg* **23** (1908): 366–368. **Brennecke.**
Tiefsee- und Hochluft-Forschungen an Bord S.M.S. *Planet*, 1906–07. Von Dr. W. Brennecke. [Abstract.]

Rivers. *Geol. Mag.* **5** (1908): 445–454. **Ellis**
On the low-water channels in rivers and estuaries. By T. S. Ellis. *Maps.*
The writer maintains that the above channels follow precisely the same laws as regards their windings as any other part of the river's course.

Soils. *Popular Sc. Monthly* **73** (1908): 5–12. **Chamberlin.**
Soil wastage. By Prof. Thomas Chrowder Chamberlin.
Discusses the possibility of checking soil-wastage by suitable methods of cultivation.

Volcanoes. *J. Franklin I.* **166** (1908): 297–307. **Hixon.**
The relation of magmatic waters to volcanic action. By Hiram W. Hixon. *Section.*

Volcanoes. *Science* **28** (1908): 277–287. **Perret.**
Some conditions affecting volcanic eruptions. By Frank A. Perret.
An attempt to correlate the fluctuations of volcanic intensity with the gravitational influence of the sun and moon.

Zoogeography. *Naturw. Wochenschrift* **23** (1908): 625–630. **Arldt.**
Afrikanische Elemente in der neogenen und quartären Fauna von Südwest Europa. Von Dr. Th. Arldt.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Anthropogeography—Glacial Epoch. *J.T. Victoria I.* **40** (1908): 51–76. **Wright**
The influence of the glacial epoch upon the early history of mankind. By Rev. Prof. G. Frederick Wright.

Archæology. **Guébhard.**
Camps et enceintes. Par le Dr. A. Guébhard. (Extrait du Congrès Préhistorique de France, III^e^ Session, Autun, 1907.) Paris, 1908. Size 9½ × 6½, pp. 997–1036. *Illustrations.*

Colonization. *Deutsches Kolonialblatt* **19** (1908): 719–727. **Steudel.**
Kann der Deutsche sich in den Tropen akklimatisieren? Von Dr. Steudel.

Commercial—Signals. *M.G. Ges. Hamburg* **23** (1908): 1–287 **Hiebel.**
Seezeichen, Leuchtfeuer und Schallsignale des Atlantischen Ozeans in ihrem Zusammenhang und ihrer Bedeutung für Wirtschaft und Kultur. Von Dr. Alfred Hiebel. *Chart.*

Disease—Sleeping-sickness. *La G., B.S.G. Paris* **18** (1908): 99–106. **Roubaud.**
Résultats actuels des travaux biologiques de la Mission d'Etudes de la Maladie du sommeil. Par E. Roubaud.

Diseases. **Manson.**
Tropical research in its relation to the Missionary Enterprise. By Sir Patrick Manson. Leyton, 1908. Size 10 × 6, pp. 12. *Illustrations.*

Historical—Drake. *B. American G.S.* **40** (1908): 449–469. **Hague.**
The Drake medal. By James D. Hague. *Illustrations and Maps.*
This is the third of the series of medals issued by the American Numismatic Society to commemorate events and persons of importance in the history of America.

Historical—Early Maps. *R. Engineers J.* **8** (1908): 159–168. **James.**
The maps of Glareanus. By Major-General C. Renouard James.
Reduced outline drawings of the maps (cf. *Journal*, June, 1905), by the author's own hand, accompany the article, and give a good general idea of their character.

Statistics. **Birot.**
Statistique annuelle de géographie comparé, 1908. Par Jean Binot. Paris: Hachette et Cie, 1908. Size 8½ × 5½, pp. 32.
A useful summary of the statistics of population, agriculture, industries, commerce etc., for the countries of the world, especial attention being given to France.

BIOGRAPHY.

Amundsen. *Deutsche Rundschau G.* **30** (1908): 469–472. **Wolkenhauer.**
Roald Amundsen. Von W. Wolkenhauer. *Map and Portrait.*

Brulé. *P. and T.R.S. Canada, Ser. III.* **1** (1907): *Sect.* 1, 87–126. **Sulte.**
Etienne Brulé. Par Benjamin Sulte.
An account of Brulé's journeys in Canada.

Burnaby. **Wright.**
The life of Colonel Fred Burnaby. By Thomas Wright. London: Everett & Co.,

1908. Size 9 × 6, pp. xxiv., 312, and x. *Portraits, Illustrations, and Sketch-maps. Price* 12*s. net. Presented by the Publishers.*

Champlain.

Bulletin de la Société de Géographie de Québec, Juillet, 1908. Quebec, 1908. Size 10½ × 7, pp. 92. *Illustrations and Facsimiles.*

Issued in connection with the recent ter-centenary celebrations.

Fleurieu. *C.R.A. Sc. Paris* **147** (1908): 235–237. **Fleurieu.**

Sur le nom de Fleurieu dans la géographie. Par de Fleurieu.

As French Minister of Marine, the Chevalier de Fleurieu did much to encourage French maritime discovery towards the close of the eighteenth century, and his name was given to various geographical features in different parts of the world, though it has dropped out of use in many cases.

Koldewey. *M.G.Ges. Hamburg* **23** (1908): 299–307. **Herrmann and Hasenkampf.**

Carl Christian Koldewey. Von Prof. E. Herrmann und Prof. v. Hasenkampf.

GENERAL.

Bibliography—Catalogue.

Catalogue of printed books in the Library of the Foreign Office: Supplement [containing books added between 1886 and 1907]. London, 1908. Size 11 × 7, pp. 614. *Presented by the Under-Secretary of State for Foreign Affairs.*

Consists of an alphabetical catalogue and subject index.

British Colonies—Surveys.

The surveys of British Africa, Ceylon, and the Federated Malay States. The Annual Report of the Colonial Survey Committee. Third year (to June, 1908). (Colonial Reports, Annual, No. 565, 1908.) Size 9½ × 6, pp. 50. *Maps and Illustrations. Price* 1*s.* 10*d.*

British Empire.

Statistical Abstract for the several British Colonies, Possessions, and Protectorates in each year from 1893 to 1907. 45th edit. London: Wyman & Sons, 1908. Size 9½ × 6, pp. 482. *Price* 2*s.*

Education. **Steinmann.**

Der Unterricht in Geologie und verwandten Fächern auf Schule und Universität. Von G. Steinmann. (Sonderabdruck aus dem VI. Bande der Zeitschrift Natur und Schule.) Leipzig: B. G. Teubner, 1907. Size 10 × 7, pp. 241–268. *Price* 1*m. Presented by the Publisher.*

Education—Maps. *G. Teacher* **4** (1908): 271–283. **Herbertson.**

Orographical maps and geographical lessons. By A. J. Herbertson.

Geneva Geographical Society. **Claparède.**

Coup d'œil sur la Société de Géographie de Genève depuis sa fondation en 1858. Par Arthur de Claparède. Nouvelle édition. Geneva, 1908. Size 9½ × 6½, pp. 78. *Portraits.*

Geography. *Scottish G. Mag.* **24** (1908): 561–575. **Chisholm.**

The Meaning and Scope of Geography. By Geo. G. Chisholm.

See January number, p. 95.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

Belgium. **Institut Cartographique Militaire.**

Carte de la Belgique. Scale 1:160,000 or 1 inch to 2·5 stat miles. Six sheets. Brussels: Institut Cartographique Militaire, 1908. *Price* 18 *fr.*

British Isles—England. **Dickinson and Andrews.**

The "Diagram" Series of Hand-maps, designed by B. B. Dickinson, F.R.G.S., and

A. W. Andrews, F.R.G.S. The Tyne Gap. Scale 1 : 520,000 or 1 inch to 8·2 stat. miles. North England. Scale 1 : 1,450,000 or 1 inch to 22·8 stat. miles. New Malden: The Diagram Co., [1908]. *Presented by the Publishers. Price 1d. each.*

Two very effective little maps, bringing out the general relief. They are orographically coloured, and without names. For the lower lands greyish-green is used, which is certainly to be preferred to the brilliant green often to be found on such maps. These maps, and others of the series to which they belong, are inexpensive, and specially suitable for schools.

England and Wales. **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from January 1 to 31, 1909.

6-inch—County Maps:—

Cornwall 75 N.W., 76 N.W., (82 N.E. and S.E.). **Hampshire** (Second Revision), 89 S.W., 94 S.W. **Lancashire** (First Revision of 1891 Survey), 90 S.W. *1s. each.*

1 : 2500 Scale—County Maps:—

Hampshire (Second Revision), LXVIII. 13, 14, 15; LXXIII. 4, 10, 11, 13; LXXIV. 8, 10; LXXVI. 4. *1s. 6d. each.* **Kent** (Second Revision), X. 13; XI. 7, 8, 11, 12, 13; XVII. 2; XIX. 15, 16; XXXI. 1, 4, 5, 7, 9, 13; XXXIX. 8; XLIX. 16; LIX. 2, 3, 6; LXIX. 4, 12, 16. *3s. each.* XXXIX. 5, 9, 13; XLIX. 13; LIX. 1, 9, 11. *1s. 6d. each.* **Lancashire** (First Revision of 1891 Survey), LXXXV. 15; XCIII. 3; CV. 6, 9; CXII. 2. **Yorkshire** (First Revision of 1891 Survey), CXLIX. 14; CLXV. 11, 12, 13; CLXVI. 2, 4, 5, 6, 7, 8, 15; CLXXXIII. 2, 3; CLXXXVI. 1, 11, 12, 16; CLXXXVII. 6; CLXXXVIII. 12; CLXXXIX. 8, 9, 10, 13; CXC. 5. *1s. 6d. each.*

(*E. Stanford, London Agent.*)

England and Wales. **Geological Survey.**

1-inch map.

New series, colour-printed. Drift Edition: Newark upon Trent, etc., Sheet 126. *Price 1s. 6d.*

(*E. Stanford, London Agent.*)

France. **Service Géographique de l'Armée, Paris.**

Carte de France. Scale 1 : 50,000 or 1·3 inch to 1 stat. mile. Sheets: XXX.–31, Lyon; XXX.–32, Givors; XXXVII.–43, Nice. Paris: Service Géographique de l'Armée, 1908. *Price 1.60 fr. each sheet.*

Holland. **Ten Brink.**

Reiskaart van Nederland. Scale 1 : 300,000 or 1 inch to 4·7 stat. miles. Five sheets. Meppel: H. Ten Brink, 1908.

Shows canals, railways, and roads up to date.

ASIA.

Asia Minor.

Karte des Sabandja Sees und Umgebung (Kleinasien). Scale 1 : 100,000 or 1 inch to 1·6 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 2. Gotha: Justus Perthes, 1909. *Presented by the Publisher.*

Asiatic Russia. **Ministry of Ways and Communications, St. Petersburg.**

Map of southern Asiatic Russia. [In Russian.] Scale 1 : 4,200,000 or 1 inch to 66·3 stat. miles. Three sheets. St. Petersburg: Ministry of Ways and Communications, 1908.

A new edition of a useful coloured map of southern Asiatic Russia, showing clearly roads, railways, telegraphs, and other information connected with means of communication. The lettering is in Russian character.

Palestine. **Schumacher.**

Karte von Ostjordanlandes. Aufgenommen von Dr. G. Schumacher. Herausgegeben vom Deutschen Verein zur Erforschung Palästinas. Scale 1 : 63,360 or 1 inch to 1 stat. mile. Sheets A 5 and B 5. Leipzig: R. Haupt, 1909.

These are the first two sheets of an important map of the country east of the river Jordan, which is being published by the German Palestine Exploration Fund from the surveys of Dr. G. Schumacher. The map is on the scale of 1 : 63,360, which is the same as that of the English Palestine Exploration Fund map of Western Palestine, of which it will therefore form a valuable continuation. It will consist altogether of twelve sheets printed in colours, each sheet measuring 23 by 22 inches.

Persia. **Stahl.**

Geologische Karte von Nordwest-Persien nach eigenen Aufnahmen von A. F. Stahl. Scale 1 : 840,000 or 1 inch to 13·3 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 1. Gotha: Justus Perthes, 1909. *Presented by the Publisher.*

This map shows the route surveys of A. F. Stahl between the Araxes, Tabriz, Hamadan and Kazwin, with the geology of the country passed through indicated by colour-tinting. It is in continuation of others previously published, and accompanies an article in *Petermanns Geographische Mitteilungen* for last month.

AFRICA.

British East Africa. **Geographical Section, General Staff.**

Jubaland. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. London: Geographical Section, General Staff, War Office, 1908. *Price 2s. Presented by the Director of Military Operations.*

Egypt. **Survey Department, Cairo.**

Topographical map of Egypt. Scale 1 : 10,000 or 6·3 inches to 1 stat. mile. Aswan Province. Sheets: S.E. 122–34, 123–35, 123–36, 123–37, 124–37, 124–38, 125–37, 125–38, 126–38, 129–38 and 39, 130–38, 130–39, 131–38, 132–39, 133–39, 134–39 and 40, 137–38, 138–38, 139–38, 142–38 and 39, 148–38, 148–39. Sharqia Province, Sheets: N.E. 8–9, 9–10. Cairo: Survey Department, 1908. *Presented by the Director-General, Survey Department, Cairo.*

Egypt. **Survey Department, Cairo.**

Topographical map of Egypt. Scale 1 : 50,000 or 1·3 inch to 1 stat. mile. Sheets: N.E. IV.–II., Mit Ghamr; VI.–II., Mansura; VI.–III., Dekernes; VII.–IV., Lake Menzala; VIII.–IV., Damietta. Cairo: Survey Department, 1908. *Presented by the Director-General, Survey Department, Cairo.*

German East Africa. **Moisel.**

Karte von Deutsch-Ostafrika. Scale 1 : 3,000,000 or 1 inch to 47·3 stat. miles. Sheet G 7, Mikindani. Berlin: Dietrich Reimer (Ernst Vohsen), 1908. *Presented by the Publisher.*

Includes the mouth of the Rovuma river with Mikindani to the north. The sheet is a new edition of that published in December, 1901.

Morocco. **Larras.**

Cartes des Reconnaissance du Maroc levées et dessinées par le Capitaine N. Larras. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Sheet: Tanger. Paris: Henry Barrère, 1909.

Captain Larras' route surveys of Morocco were noticed in the *Geographical Journal* for October, 1908. This sheet just published includes Tangier and the country to the south. There are inset plans on enlarged scales of Tangier, El Qçar el Kebir, and El Araïch.

Senegal. **Gouvernement Général de l'Afrique Occidentale Française.**

Carte du Senegal. Scale 1 : 100,000 or 1 inch to 1·6 stat. miles. Sheets: IV. Merinaghen; V. N'Bétète; VI. Kelle; XII. Nianing; XV. Sangomar. Paris: Service Géographique du Gouvernement Général de l'Afrique Occidentale Française, [1908]. *Price 2 fr. each sheet.*

Five additional sheets of the large scale-map of Senegal, the first of which were noticed in the *Geographical Journal* for January, 1906. They are printed in colours, contour-lines at intervals of 10 metres being printed in brown.

South Africa. **Seiner.**

Karte des Gebiets zwischen Okawango und Sambesi (Caprivi-Zipfel) nach den Aufnahmen von Franz Seiner in den Jahren 1905–1906. Unter Leitung von Paul Sprigade gezeichnet von George Krause. Scale 1 : 500,000 or 1 inch to 7·9 stat. miles. *Mitteilungen a. d. deutschen Schutzgebieten*, Band xxii. 1909. Karte I. Berlin: E. S. Mittler & Sohn, 1907. *Presented by the Publishers.*

Includes the strip of German territory extending from the Okavango to the Zambezi and the country immediately to the north and south of this. The map is very complete for its kind, and gives considerable detailed information concerning the character of the country. It also shows routes of earlier travellers, with their names attached.

Tunis. **Service Géographique de l'Armée, Paris.**

Carte de la Tunisie. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets: LXVII.,

El Ayaïcha; LXXX, Mennchia; LXXXII., Oglat Merteba; LXXXIX., Douz; XCVIII., Bir Soltane; C., Kirchaou. Paris: Service Geographique de l'Armée, [1908]. *Price* 1.20 *fr. each sheet.*

AMERICA.

Canada. **Department of the Interior, Ottawa.**

Sectional map of Canada. Scale 1: 190,080 or 1 inch to 3 stat. miles. Sheets: 114, Calgary, revised to May 22, 1908; 115, Blackfoot, revised to October 24, 1908; 167, Bad Hills, revised to August 19, 1908; 219, Humboldt, revised to April 29, 1908. Ottawa: Department of the Interior, Topographical Surveys Branch, 1908. *Presented by the Department of the Interior, Ottawa.*

GENERAL.

World. **Bisiker.**

The British Empire (and Japan): Its features, resources, commerce, industries, and scenery, together with the physical and economic conditions of the world. A modern atlas having 213 maps and 272 illustrations, numerous tables and diagrams, with text concerning the illustrations, commercial products, statistics, histories, etc. By W. Bisiker, F.R.G.S. London: Geographical Publishing Co., 1909. *Price* 21*s.* *Presented by the Author.*

In several respects this atlas is original in its arrangement and design, and the author states in his preface that it is intended as a contribution to "Education and Empire," concerning which so much correspondence took place in the press at the time of the last Colonial conference. The title, 'The British Empire and Japan,' is somewhat remarkable, but Japan has been dealt with more fully than other non-British countries, as it is an important ally. The atlas consists of a series of 212 maps and 272 illustrations, together with numerous tables, diagrams, and full descriptive text, all of which are entirely new, and have taken many months to prepare, under the careful and painstaking supervision of Mr. W. Bisiker, who holds the diploma of the Oxford School of Geography. Previous to dealing with the British Empire in detail, a series of fifteen general maps of the world and continents is given. These treat of projections, meteorological phenomena, currents, heights of land and ocean depths, vegetation, and other matters connected with physical geography. Then follow thirty-one maps of the various parts of the British Empire throughout the world, commencing with the British Isles and finishing with a sheet of maps of the smaller British possessions. Last of all come two pages devoted to Japan; but as these maps are very small and general in character, they hardly seem to justify the special reference to Japan given in the title. A special feature of the atlas is the relief maps, which are certainly effective, and have much the appearance of photographs of models, and show, in addition to land relief, the depths of water by tints of blue. Upon these the railways are laid down, as the routes they follow are naturally dependant upon the relief of the country. These maps are on the same scale as the general political and commercial maps, which are without hills, and the two are placed so as to face each other in the atlas. One half of the page containing the relief map is taken up with views of scenery, types of natives, flora and fauna, which are described in text at the end of the atlas. Finally, an index to place-names is given.

Altogether this atlas contains a great deal of useful information, and it should form a useful supplement to the ordinary general atlas. It has entailed a considerable amount of labour, which is hardly done justice to by the small scale of the maps. The scale of the maps might with advantage have been larger, even at the expense of the pictures, if no other arrangement could have been made.

World. **Johnston.**

The Edinburgh School Atlas. Edinburgh: W. & A. K. Johnston, Ltd., [1909]. *Price* 1*s.* *Presented by the Publishers.*

A small general atlas intended for use of schools. It contains thirty-two maps, showing height of land by shades of brown, over vertical hachuring, and depths of water in tints of blue. The black hachuring under the brown tints tends rather to confuse the lettering of the maps, and they would have been clearer with the tinting alone to show relief.

World. **Vidal-Lablache.**

Atlas Général Vidal-Lablache: Histoire et Géographie. 420 Cartes et Cartons: Index Alphabetique de 46,000 noms. Livraisons 4, 5, and 6. Paris: Amand Colin, 1909. *Price* 1.10 *fr. net each part.*

The following maps are contained in these parts :—Part 4 : No. 3, Asie Occidentale pendant l'Hégémonie Assyrienne (IX.–VII^e. Siècle au. J.C.) ; 4 and 5, Empire des Perses ; 6, Grèce Ancienne ; 73, France, Navigation ; 74 and 75, France, Méridionale ; 76, France, Divisions Militaires. Part 5 : No. 7, Grèce Ancienne ; 8 and 9, Mediterranée du VII^e. au V^e. Siècle au J.C. : 10, Hellade pendant la Guerre du Péloponnèse ; 53, Régions Polaires ; 54 and 55, Mappemonde ; 56, Courants and Climats. Part 6 : No. 11, Royaume de Macédoine ; 12 and 13, Empire d'Alexandre ; 14, Italie Ancienne, partie septentrionale ; 65, Produits Agricoles ; 66 and 67, France, Administrative ; 68, France, Industrie.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during December, 1908. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
3710 m	8·9 / 4·8	North American lakes. Plans in Lake Erie :—Dunkirk harbour, Cleveland harbour. 3*s*.
3717 m	9·9 / 4·9	Plans in Tasmania :—River Mersey, Emu bay. 3*s*.

Charts Cancelled.

No.		Cancelled by	No.
1079	Tasmania :—Plan of Emu bay on this sheet.	New Chart. Plans in Tasmania :—River Mersey. Emu bay	3717

New Editions.

No. 2635, Scotland, west coast. 2386, Scotland, west coast :—Cape Wrath to the Flannan islands. 1607, England, east coast :—North Foreland to the Nore. 1823, Scotland, east coast :—Banff to Dunbeath harbour. 1954, Scotland, north coast :—Thurso bay to the North Minch. 1824*b*, Ireland, west coast. 1753, Ireland, east coast :—Belfast lough. 3262, Germany, Elbe river : Brunsbuttelkoog to Hamburg. 1846, France :—Villefranche bay. 2435, Alaska :—Mackenzie river to Bering strait. 1754, China, east coast :—Tung yung to Wen chau bay. 1763, China, east coast :—Wen chau port and approaches. 1112, Society islands :—Manga reva or Gambier islands.

Danish Charts. **K. Danske Søkort-Arkiv.**

Danish Admiralty Charts. Nos. 223, Lille-Bælt, nordlige del ; 224, Færöerne Havne og Ankerpladser ; 225, Islands Sydkyst, östlige del. Vestrahorn-Portland. Copenhagen : Kongelige Danske Søkort-Arkiv, 1908. *Presented by the Danish Admiralty.*

Indian Ocean and Red Sea. **Meteorological Office.**

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, February, 1909. London : Meteorological Office, 1909. *Price 6d. each. Presented by the Meteorological Office.*

Morocco. **Mission Hydrographique au Maroc.**

Hydrographic charts : Rade de Casablanca ; Mazagan ; Mazagan et ses atterrages ; Mogador ; Mogador et ses atterrages ; Rade de Rabat Salé ; Rade de Saffi ; Saffi et ses atterrages. Paris : Comité du Maroc, [1908].

North Atlantic and Mediterranean. **Meteorological Office.**

Monthly meteorological charts of the North Atlantic and Mediterranean, February 1909. London : Meteorological Office, 1909. *Price 6d. each. Presented by the Meteorological Office.*

North Atlantic. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic Ocean, January and February, 1909. Washington : U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

North Pacific. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, February, 1909. Washington : U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

World. **U.S. Hydrographic Office.**

The Variation of the Compass for the year 1910: Lines of Equal Annual Change of the Variation of the Compass for the year 1910. Washington: U.S. Hydrographic Office, 1908.

A chart of the world on Mercator's projection, showing the variation of the compass by curves in the usual manner, drawn for the year 1910, and prepared from all the available observations up to the date of issue. On the back of the principal chart is another showing the lines of equal annual change for 1910, expressed in minutes of arc.

PHOTOGRAPHS.

Bechuanaland. **Hodson.**

Forty-six photographs of the Bechuanaland Protectorate, taken by A. W. Hodson, Esq. *Presented by A. W. Hodson, Esq.*

This is a set of small photographs, principally of animals and sporting trophies, mounted in an album:—

(1–4) Leopard; (5–8) Waterbuck; (6) Sable antelope; (7) Wildebeeste; (9) Gemsbuck; (10) Kudu; (11 and 12) Warthog; (13) Wild goose; (14) Carcase of leopard; (15) Black Mamba snake; (16) Silver jackals; (17) Children bathing; (18) Bushmen stalking game; (19) Government hut, Sebenane; (20) Forest, Sebenane; (21 and 35) Crossing dry river-bed; (22) In dry river-bed; (23) Bushman woman; (24) Government camp, Sebenane; (25 and 33) Pala road; (26 and 32) Makalakas building hut; (27) Reedbuck on donkey; (28) A Mongwato native and his children; (29) A baby Bushman smoking; (30 and 34) Nata river; (31) Chief Khama; (36) Two jackals; (37) Fish from Sebenane pool; (38) Building hut; (39 and 45) Bushman with large mushroom; (40) Children playing, Pala road; (41) Bushmen in huts; (42) Bushman boys; (43) Biltong drying; (44) The Great Makarakari salt lake; (46) Long grass on Nata river.

Himalayas. **Longstaff.**

Twenty-five photographs of Kumaon and Manasarowar Region of Tibet, taken by T. G. Longstaff, Esq., M.A., M.D. *Presented by T. G. Longstaff, Esq., M.A., M.D.*

Nos. 1 to 9 of these photographs were taken by Dr. Longstaff during his journey in 1905, whilst Nos. 10 to 25 are from his last expedition's work in Garhwal, during the summer of 1907. Both of these journeys are described in the *Geographical Journal*. The views are all interesting and well taken. Dr. Longstaff has added considerably to their value by the careful manner in which he has described them, and the notes he has added on the mounts.

(1) South face of Nanda Devi from 20,000 feet; (2) Nanda Devi, looking north-west from north-north-east ridge of Nanda Kot; (3) Nanda Kot; (4) Peak marked Nampa, 23,352 feet, in north-west corner of Nepal; (5) Lipu Lekh pass, massif of Gurla Mandhata in distance; (6) Gurla Mandhata, etc., from west-south-west; (7) Valley south of peak 22,200 feet, Gurla; (8) Rakas Tal from west ridge, Gurla; (9) Western ridge of Gurla; (10) Peak 22,200 feet from west ridge of Gurla; (11) Lower part of Gurla glacier; (12) Snout of Gurla glacier; (13) South-west corner, Manasarowar lake; (14) Gozul Gompa and Manasarowar lake; (15) Jiu Gompa and Channel with salt deposits connecting Manasarowar and Rakas Tal; (16) Jiu Gompa and channel bed as seen from very edge of Manasarowar lake; (17) Kailas Parbat from west-north-west of Darchen on road to Karlep; (18) Old lagoons, near Barkha; (19) My yaks fording Sutlej at Tirthapurri; (20) Baggage crossing Dharma Yangti; (21) Snout of "Kurumboli" (Kail) glacier; (22) Upper part of Kail glacier; (23) Looking down the Kail glacier from the south slopes of the middle peak of Trisul; (24) "Trisul Gap" from the head of the "Trisuli" glacier; (25) View from Mana or Chirbattia pass, looking north into Tibet.

Iceland and Faröe Islands. **Stackhouse.**

Twenty-four photographs of Iceland and the Faröe Islands, taken by J. Foster Stackhouse, Esq. *Presented by J. Foster Stackhouse, Esq.*

A typical set of photographs taken during a holiday trip last summer.

(1–3) Reykjavik; (4) One of the boiling springs, Reykjanes; (5) Driftwood, south coast; (6) A mud pool; (7) Lava; (8) The solfataras of Kriswick; (9) Rock-strewn shore, Reykjanes; (10) The start from camping-place; (11–13) A young Icelandic lady; (14 and 15) Off Vestmann islands; (16 and 17) Biarnarey island; (18) Heimacy island; (19) North side of Heimacy island; (20) Distant view of Heimacy island; (21) Iceland mailboat off Portland, Iceland; (22) Passage between Faröe islands; (23 and 24) Klaksvig fiord.

Japan. **Waley.**

One hundred and ten photographs of Japan. *Presented by A. S. Waley, Esq.*

Nine of these are large coloured photographs taken by a Japanese photographer; the remainder, which are small, were taken by Mr. A. S. Waley. From the titles it will be seen that some of the subjects are of special interest.

(1 and 2) Government buildings, Tokyo; (3) Street scene, Tokyo; (4) Fire watch-tower, Tokyo; (5) The main entrance to the palace, Tokyo; (6) A funeral, Tokyo; (7) In Shiba park, Tokyo; (8) Shiba temples, Tokyo; (9) Street scene, Nagasaki; (10) Mess shop, Nagasaki; (11) The waterfall, Nagasaki; (12) View from the Great Temple, Nagasaki; (13) The foreign settlement, Kobe; (14) The big Buddha, Kobe; (15) Diabutsu, Kobe; (16) Yokohama harbour; (17–22) Nikko; (23 and 24) The Sacred Bridge, Nikko; (25) Road of Cryptomeria, leading to tomb of first Shogun, Nikko; (26) A guardian of the temple, first Shogun; (27) Entrance tomb, third Shogun; (28) Interior of tomb, third Shogun; (29 and 30) Sorinto, Nikko; (31) Stone Buddhas, Nikko; (32) The Pool, Nikko; (33–35) On the road to Chuzenji; (36–40) Lake Chuzenji; (41 and 42) The Great Waterfall, Chuzenji; (43) Our transport, Nikko-Chuzenji; (44–46) Kyoto; (47) Kyoto from Yaami hotel; (48) The great wooden Diabutsu, Kyoto; (49) Kwannon, Kyoto; (50) The Running Temple of Buddha, Kyoto; (51) Inari temple, Kyto; (52) View from Inari temple; (53) Chion-in, Kyoto; (54) A curious tree, Kyoto; (55-63) The Matsuri festival, Kyoto; (64 and 65) Arashi Yama, near Kyoto; (66) Katsu Yama rapids, Kyoto; (67) The ascent of Fuji Yama; (68) Halfway up Fuji Yama; (69) The top of Fuji Yama; (70) The absolute summit of Fuji Yama; (71) The crater of Fuji Yama; (72) Looking down into the crater of Fuji Yama; (73) Fuji Yama from Gotemba; (74) Fuji Ya hotel, Miyanoshita (75 and 76) Kamakura; (77–79) The great Diabutsu, Kamakura; (80 and 81) Lotus pond, Kamakura; (82 and 83) Enoshima; (84–86) The inland sea; (87) Street in Saga; (88) Moji from the sea; (89) Atami; (90) A garden at Atami; (91) The Great geyser, Atami; (92) Hakone from Atami pass; (93 and 94) At Ureshino; (95) Takeo; (96) Street scene, Takeo; (97) Pagoda at Nara; (98) The Ten Province Stone; (99) Solfataras at Unzen; (100) Waterfall near Unzen; (101–103) O Mochi San; (104) Tsahaya; (105) The old bridge, Tsahaya; (106) Waterfall, Gifu; (107) Flower kept alive by putting in water; (108) Cryptomeria on the way to Nikko; (109) Walking in a garden; (110) Dancing and singing girls.

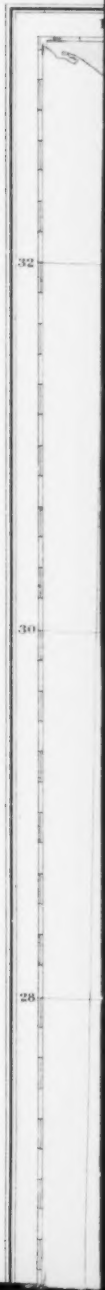
Nyasaland. **Piercy.**

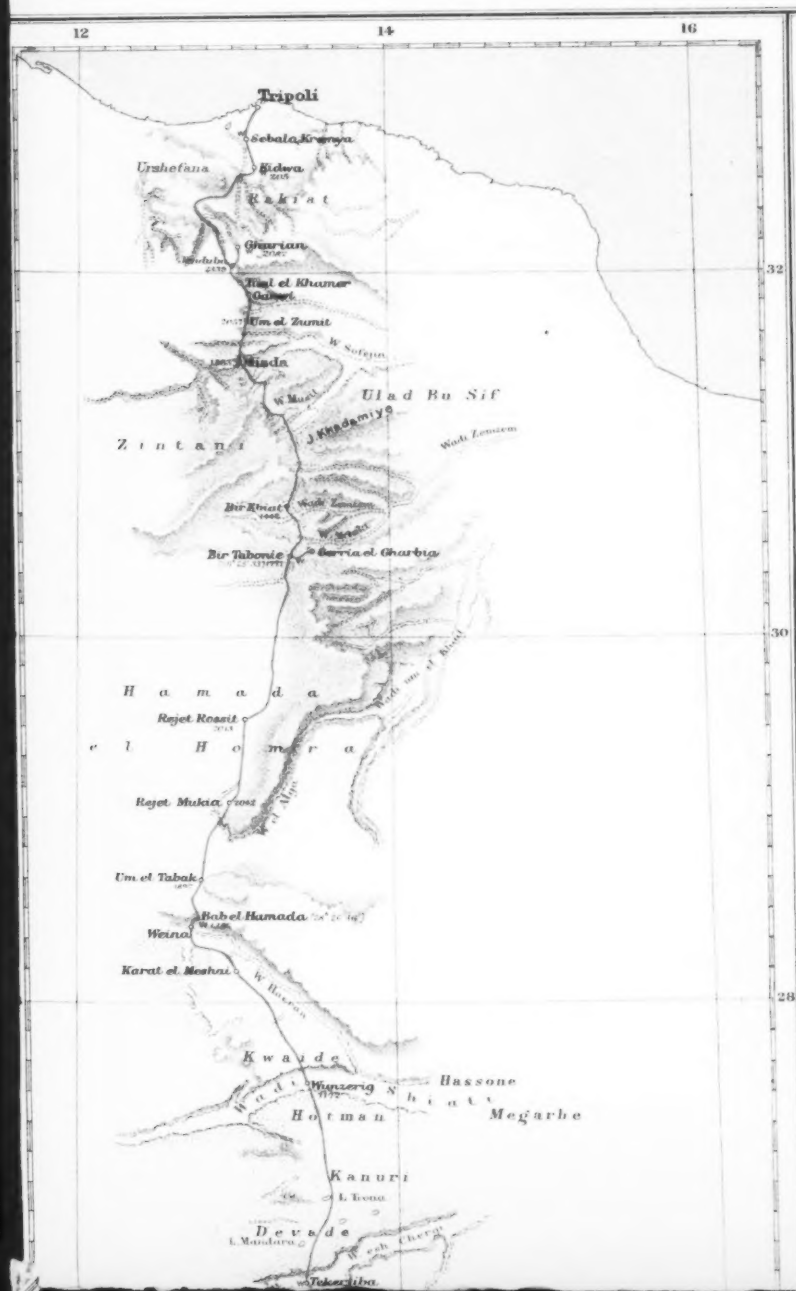
Thirty-four photographs of Nyasaland, taken by the Rev. W. C. Piercy. *Presented by the Rev. W. C. Piercy.*

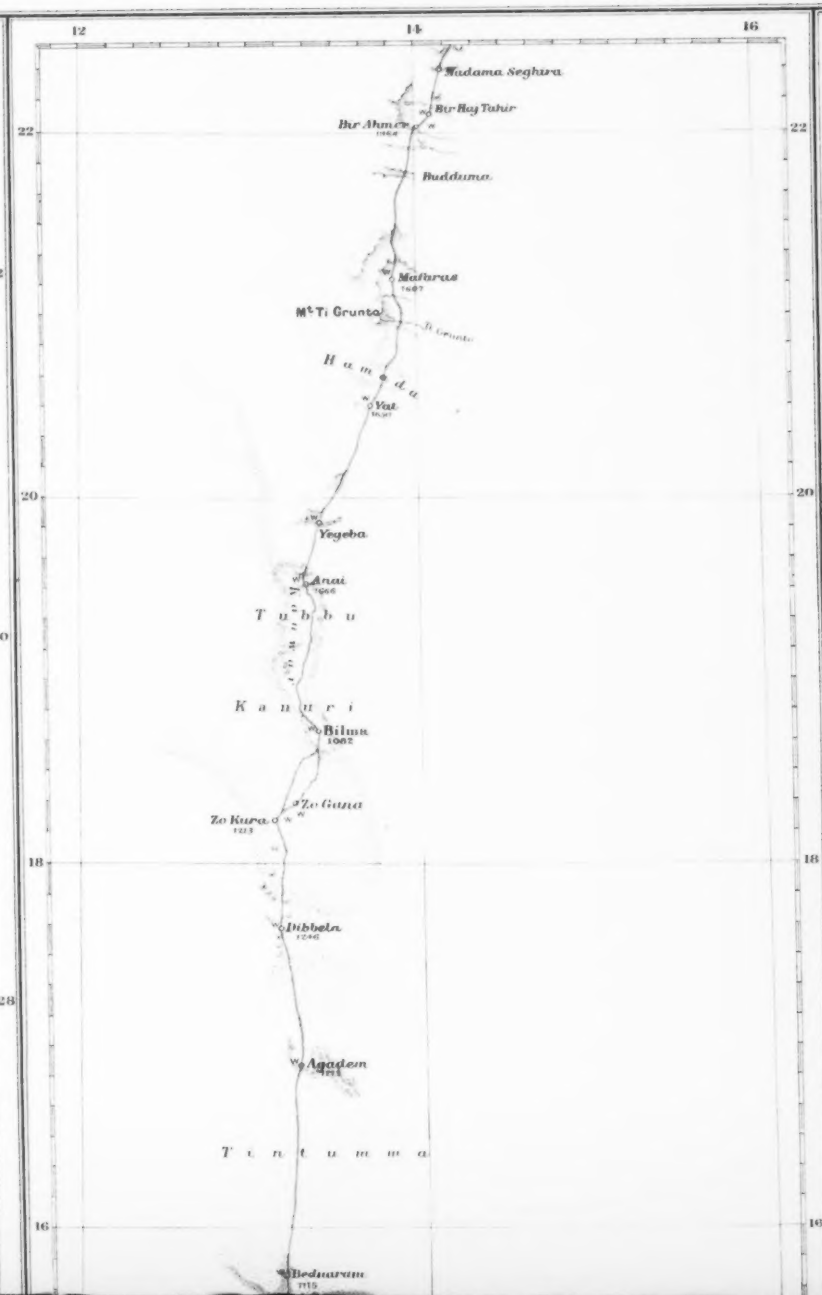
In addition to the types of scenery and natives, these photographs serve well to illustrate the recent progress and development of Nyasaland.

(1) Marabout stork, Chinde; (2) Engine on the Shiré Highlands Railway; (3) The Port Herald terminus of the Shiré Highlands Railway; (4) Waterfall at foot of Cholo hill; (5) Natives clearing a channel, upper Shiré; (6) A corner of Monkey bay; (7) Buying wood, Lake Nyasa; (8) Likoma island, Lake Nyasa; (9) The cathedral, Likoma; (10) Shore of southern end of Lake Nyasa; (11) The estuary of the Chia river; (12) Sani hill from north-east; (13) Sani hill from south-west; (14) Sani village; (15 and 16) Sani bay; (17) Tree growing between two rocks; (18) The avenue to the Boma (Government offices), Kota-Kota; (19) Two Wa-Nyanja girls, Kota-Kota; (20) Natives making bricks, Kota-Kota; (21) A game of ball with the village children, Kota-Kota; (22) A herd of African humped cattle, Kota-Kota; (23) The ford of the Kaombe river; (24) A group of native boys, Tiwi; (25) A creeper in the village of Tiwi; (26) A Government official residence, under the lee of Mount Ngara; (27) Mount Ngara; (28 and 29) Travelling in Nyasaland, machila (hammock) and carriers; (30) A native dug-out on Lake Tabe-tabe; (31) Chief Mbaruka of Chiganga; (32) The "Giant's Thumb" anthill; (33) A church built for £5; (34) The "Vungati" tree.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.


32
30
28


12
14
16
Tripoli
Sebala Kreenya
Ursheiana
Bidwa
Rakiat
Ghurian
Tmt el Khamer
Gasser
Um el Zumit
W Sofegin
Nisda
W Mudi
Ulad Bu Sif
Zintani
J Khadamiya
Wadi Lemsem
Bir Rmat
Wadi Zemlem
W Mudi
Bir Tabonie
Garria el Gharbia
Hamada
Rejet Rosait
el Homra
Rejet Mukia
Um el Tabak
Bab el Hamada
Weina
Karat el Meshai
W Hasera
Kwaida
Wadi Winzerig
Hassone
Shiati
Hotman
Megarbe
Kanuri
I. Tesna
Devade
I. Mandara
Wadi Charra
Tekerriba
32
30
28


12
14
16
Tadama Seghira
Bir Ray Tahir
Bir Ahmer
Budduma
Mafuras
Mt Ti Grunto
Hamada
Yat
Yegeba
Anai
Tubbu
Kanuri
Bilma
Zo Guna
Zo Kura
Dibbela
Agadem
Tintumma
Bedmarma
22
20
18
16

Sketch Map
to illustrate the journey
of
HANNS VISCHER
ACROSS THE SAHARA
from
Tripoli to Lake Chad.

Scale, 1:4,000,000 or 1 inch = 63·13 Stat. Miles

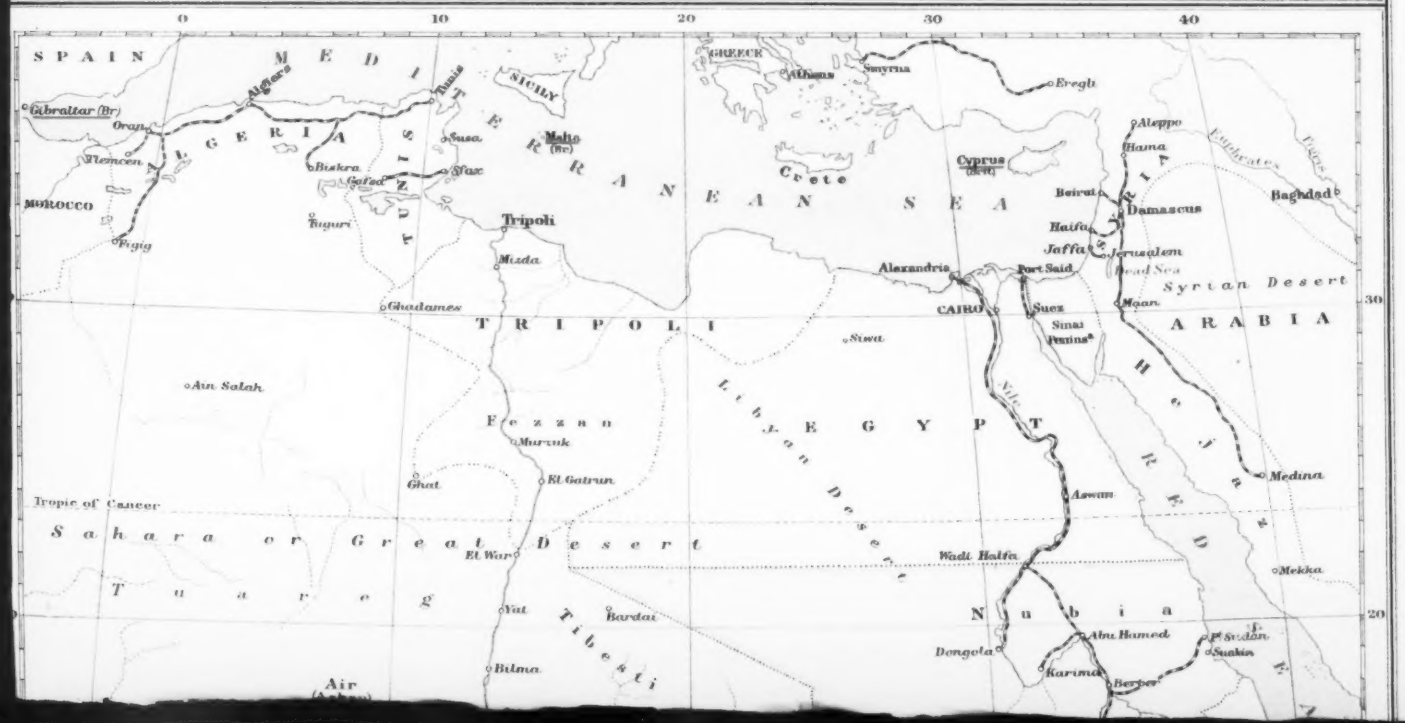
50 0 50 100

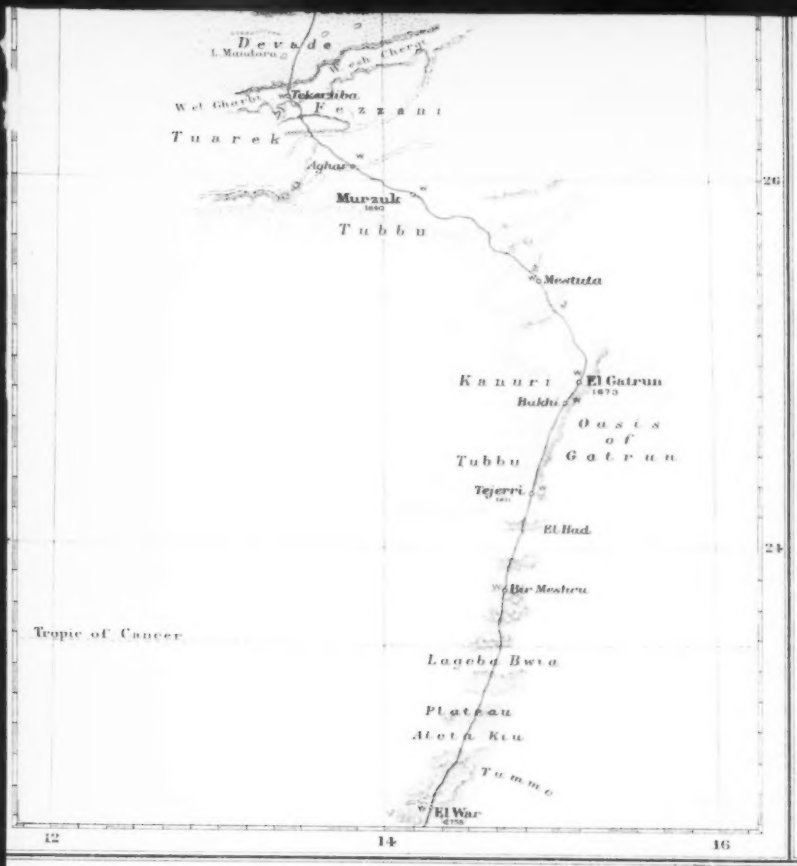
Reference

Route
Water
Sand
Heights in feet

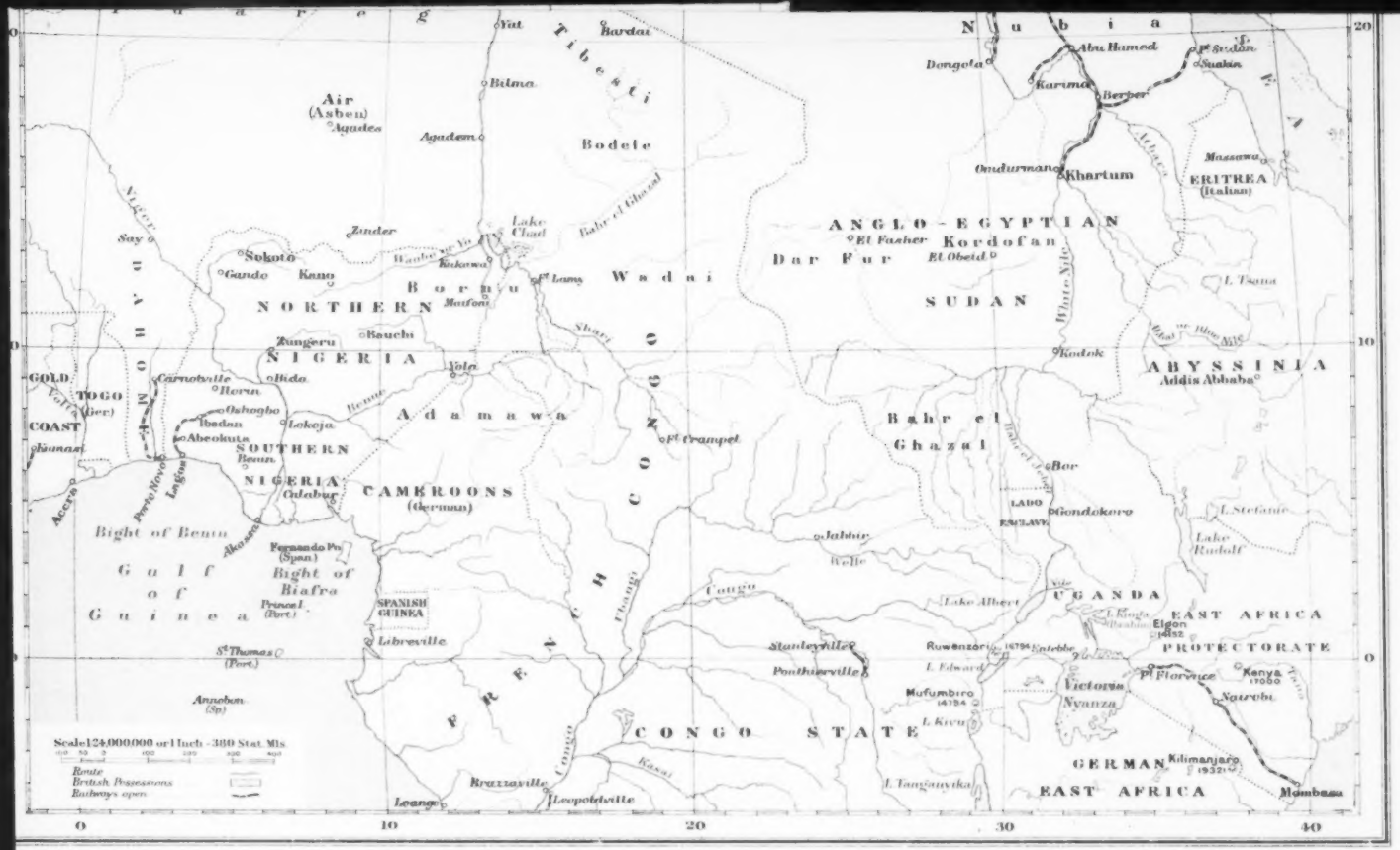
Note

The heights between Tripoli and Murzuq are from M. Hanns Vischer's Barometrical observations





Published by the Royal Geographical Society


Nubia
Tibesti
Air (Asben)
Agades
Bilma
Bodele
Bardai
Dongola
Abu Hamed
Sudan
Suakin
Karima
Berber
Atbara
Massawa
ERITREA (Italian)
Omdurman
Khartum
ANGLO-EGYPTIAN SUDAN
El Fasher
Kordofan
Dar Fur
El Obeid
Lake Chad
Bahr el Ghazal
Zinder
Say
Sokoto
Gando
Kano
Bauchi
Zungeru
NORTHERN NIGERIA
Borgu
Wadai
Lamy
Mafoni
Kukawa
Yola
Shari
Kodok
White Nile
Blue Nile
L. Tsana
ABYSSINIA
Addis Abbaba
GOLD COAST
TOGO (Ger.)
Carnotville
Ilorin
Ibadan
Oshogbo
Lokoja
Abeokuta
Lagos
Porto Novo
Benin
SOUTHERN NIGERIA
Calabar
Adamawa
CAMEROONS (German)
Ft Crampel
Bahr el Ghazal
Bar
LADO ENCLAVE
Gondokoro
L. Stefanie
Lake Rudolf
Jabbir
Welle
Congo
Lake Albert
UGANDA
EAST AFRICA PROTECTORATE
Elgon 14120
Ruwenzori 16794
Entebbe
Mt Florence
Kenya 17050
Nairobi
Victoria Nyanza
Mafumbiro 14184
L. Kivu
Stanleyville
Ponthierville
L. Edward
Bight of Benin
Gulf of Guinea
Bight of Biafra
Fernando Po (Span.)
Princes I. (Port.)
St Thomas (Port.)
Annobon (Sp.)
SPANISH GUINEA
Libreville
FRENCH CONGO
CONGO STATE
Brazzaville
Leopoldville
Loango
Kasai
L. Tanganyika
GERMAN EAST AFRICA
Kilimanjaro 19321
Mombasa
Scale 1:24,000,000 or 1 Inch = 380 Stat. Mls.
Route
British Possessions
Railways open
0
10
20
30
40

MAP OF
WALES

SHOWING DISTRIBUTION OF MEAN ANNUAL RAINFALL.

Illustrating a Paper by

GEORGE BRANSBY WILLIAMS.

Natural Scale 1: 760,320 or 1 Inch = 12 Stat. Miles.

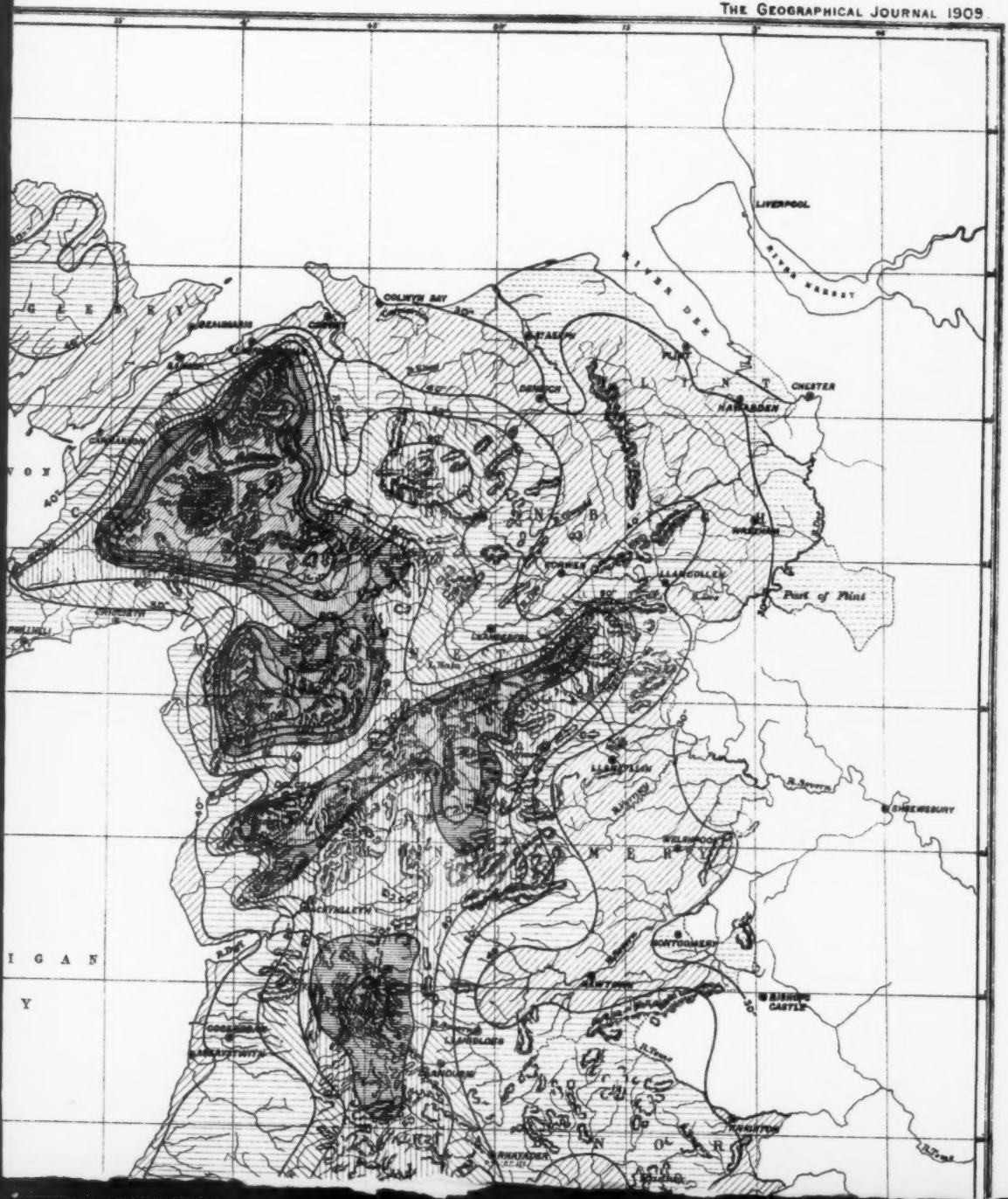
0 5 10 15 20 Miles

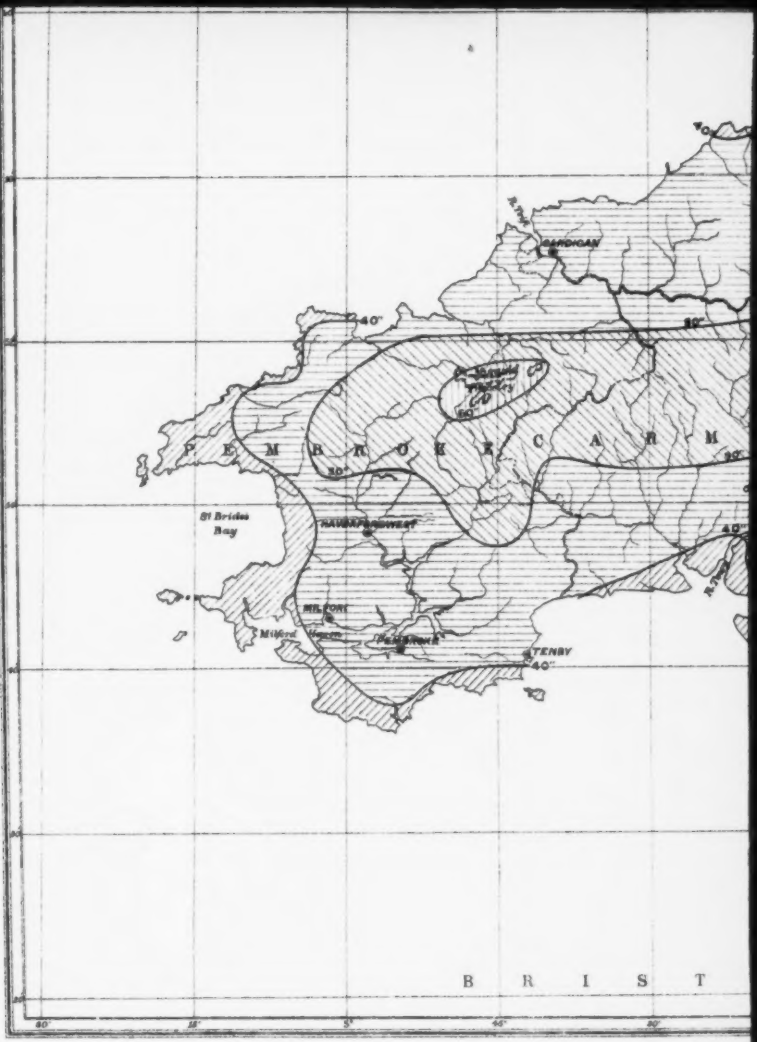
CARDIGA

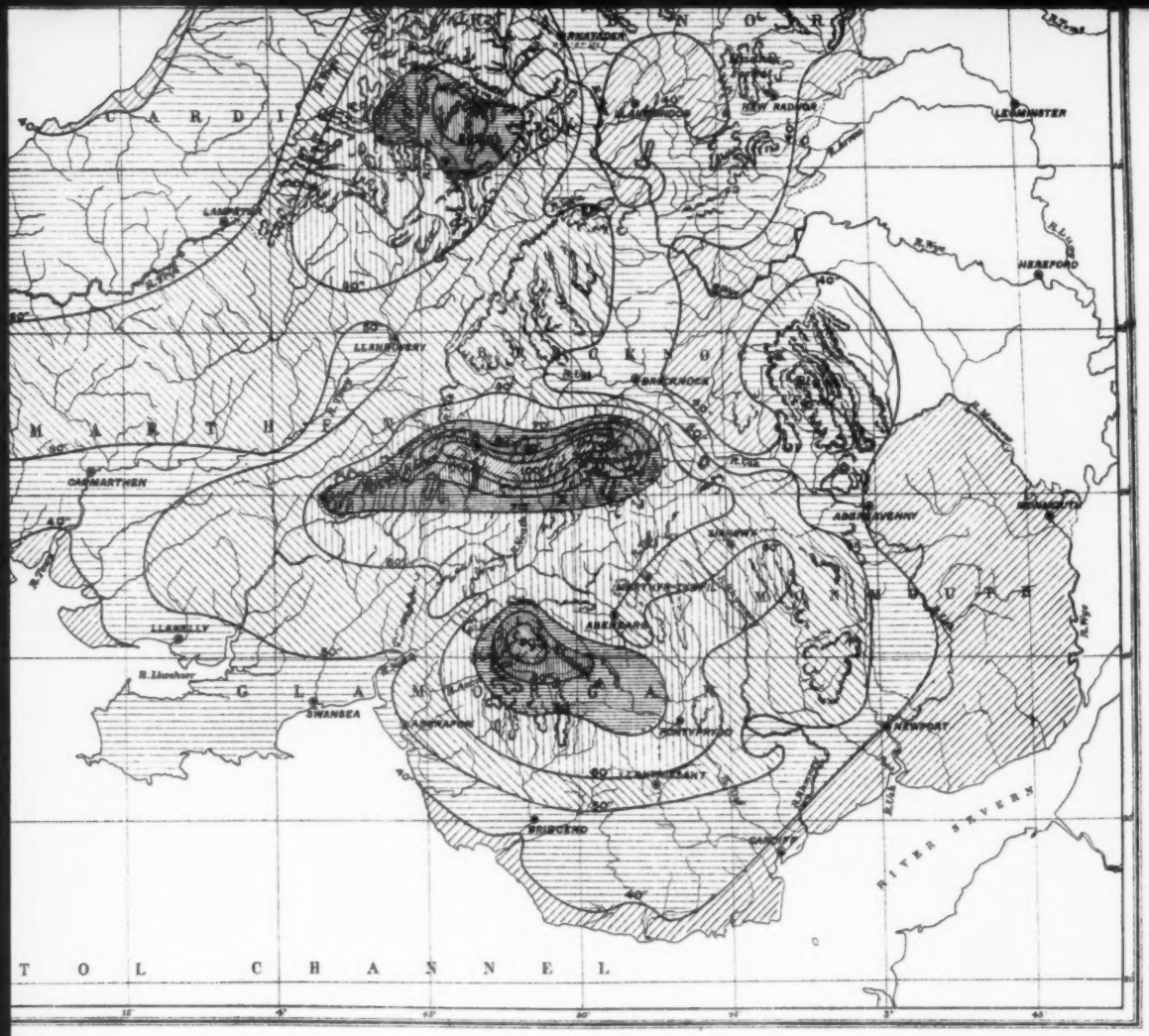
BAY

RAINFALL OF WALES
WILLIAMS.

THE GEOGRAPHICAL JOURNAL 1909.




CARDIGAN
40°
35°
PEMBROKE
CARM
30°
St Brides Bay
HAVERFORDWEST
40°
MILFORD
Milford Haven
PEMBROKE
TENBY
40°
BRIST
40'
15'
5°
55'
50'



Published by the Royal Geographical Society.